

NORMAN DISNEY & YOUNG

Consulting Engineers



The Sustainable Laboratory Building Challenges from a current project

Labs 21 Conference

Denver Colorado

22-24 October 2003

Patrick Fogarty

Director



The Burlington Danes Project

- ❑ The Project
- ❑ How the Building Works - Flexibility and Modularity
- ❑ Initial Environmental Measures – Concept Design
- ❑ What Next ? - The Hard Yards – Detail Design and beyond
- ❑ The Project today

Imperial College
London



The Design Team

Services Engineers



Architects



Structural Engineers

Adams Kara Taylor

Cost Planners

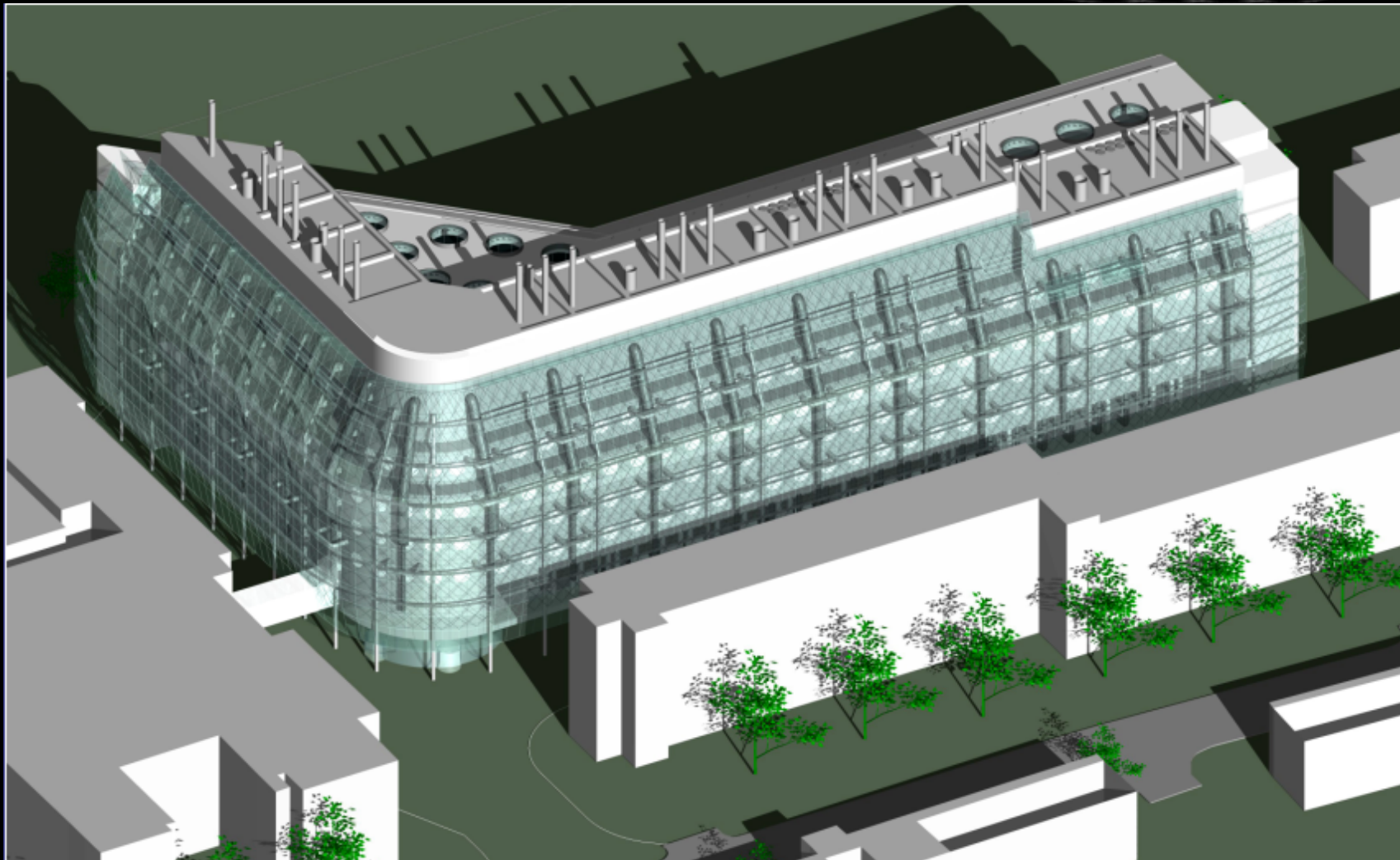


The Project Flexibility & Modularity Concept Design Detail Design Project Today

The Project

- ❑ Circa 20,000 m²
- ❑ Flexible Laboratory Space including
 - Cat 2 & 3 Biological Research Laboratory
 - Associated write-up & support areas
 - Research Medical Imaging Facility
 - Biological Services Unit
- ❑ Multiple Tenants
 - Major Educational Research Facility
 - Global Pharmaceutical Company
 - Key Charitable Research Organisation
- ❑ Connection and Relationship to Primary Teaching Hospital





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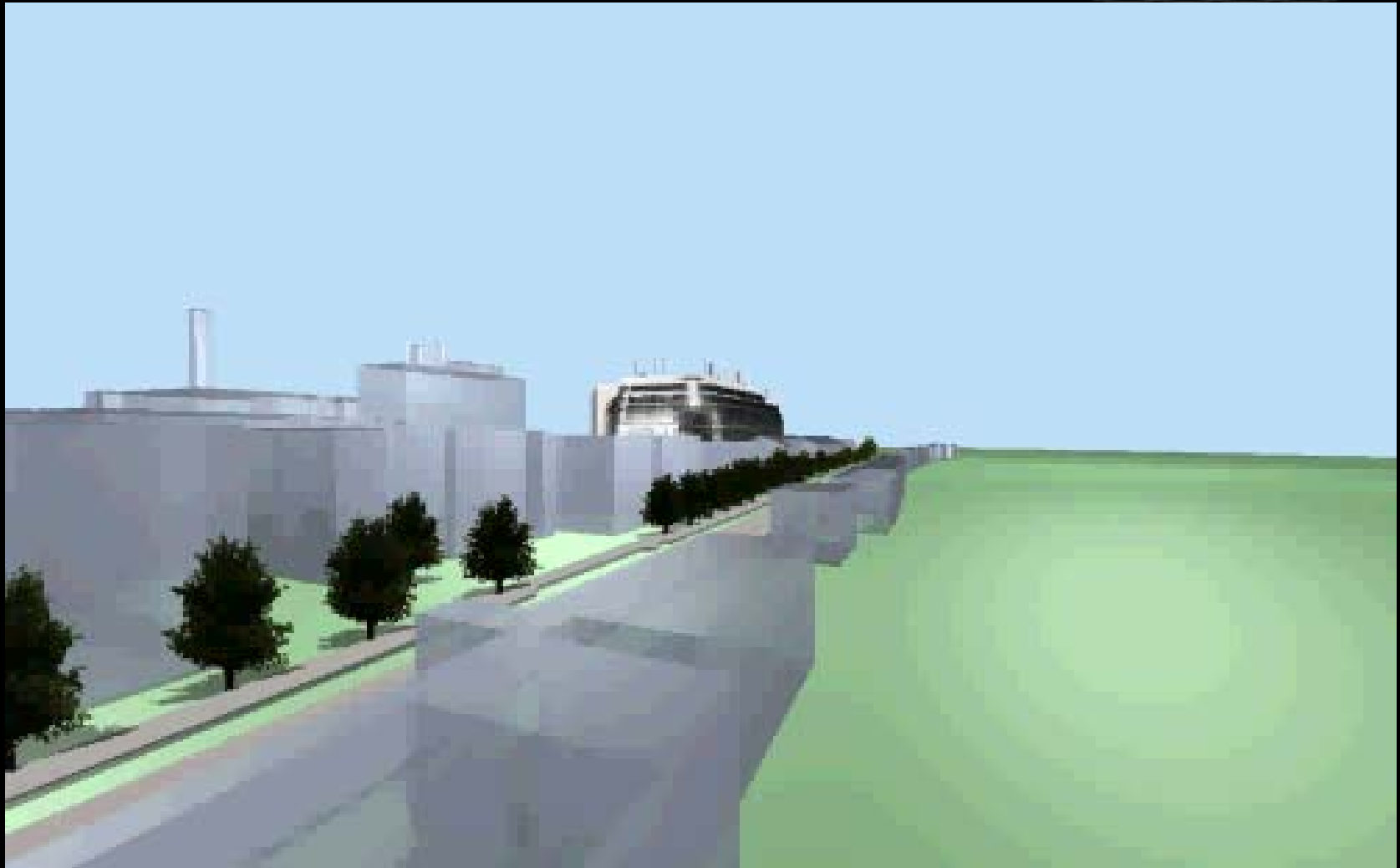


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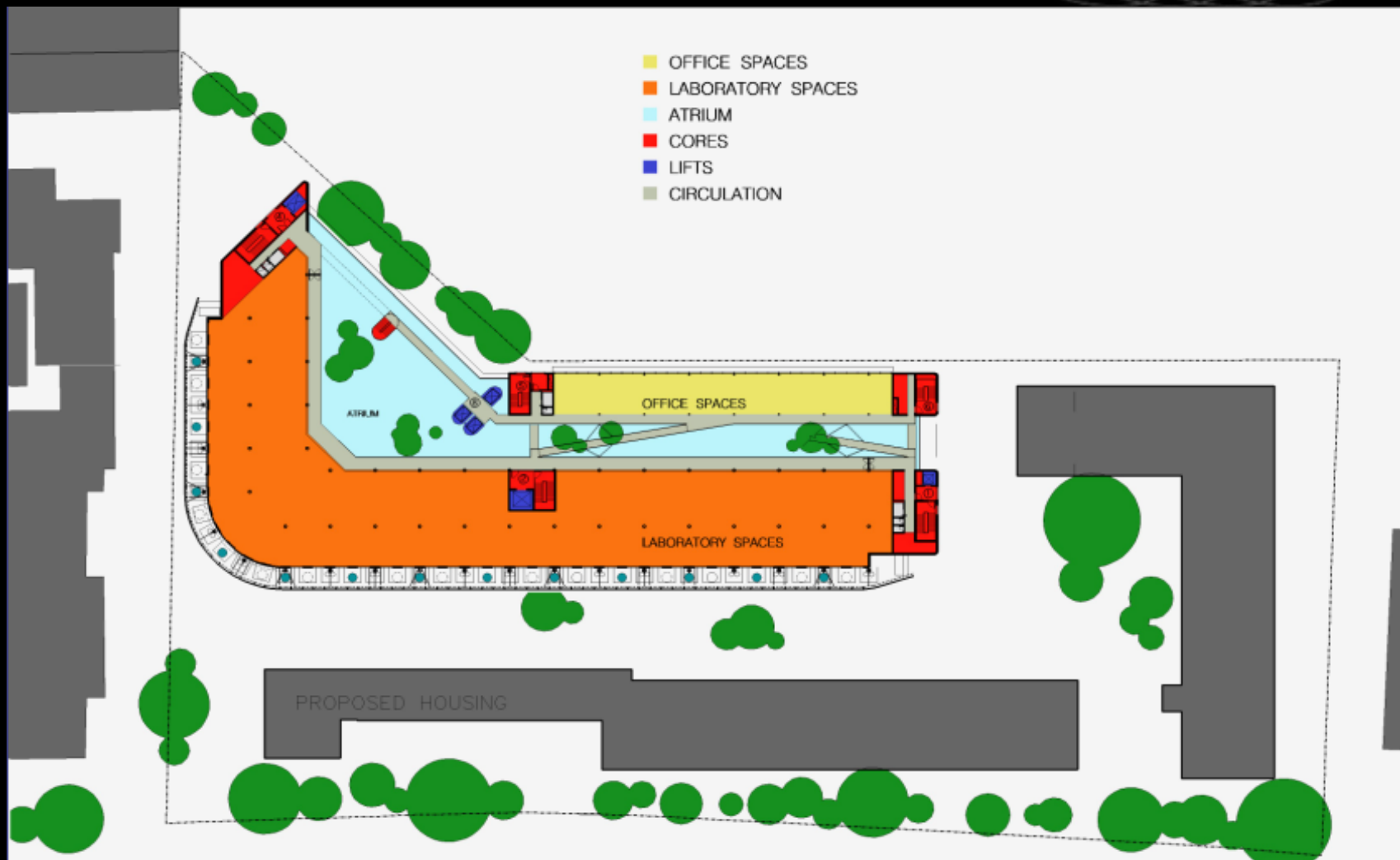
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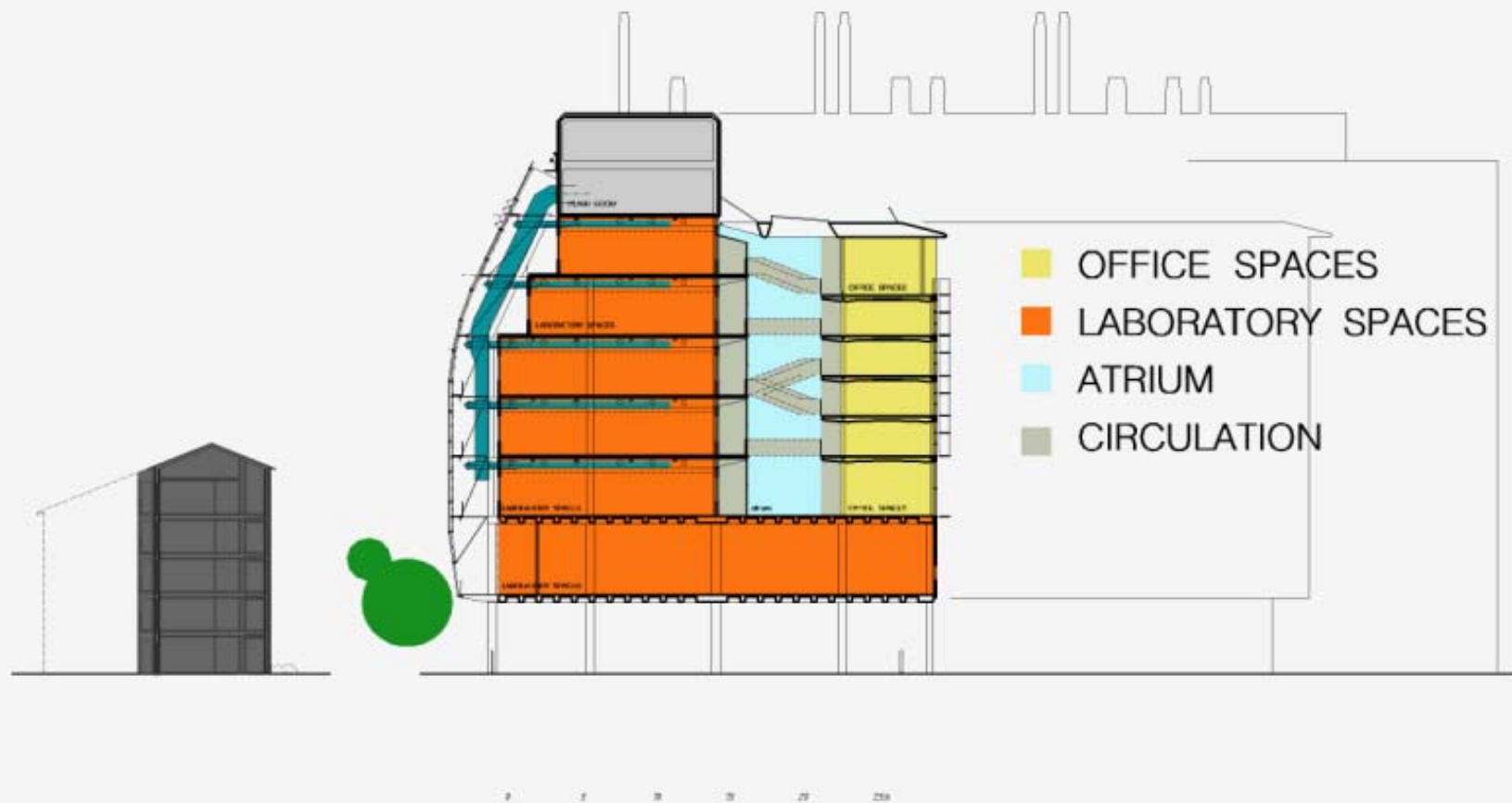
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Flexibility & Modularity – the drivers

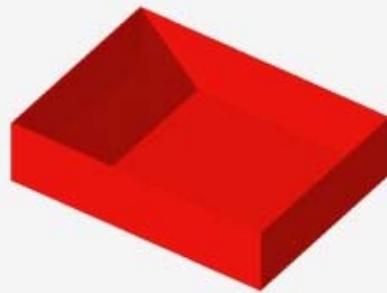
- ❑ Provide space suitable for a range of functions
- ❑ Minimise disruption to Co-Tenants
- ❑ Provide open plan flexible space
- ❑ Minimise future requirements for reconfiguration of space



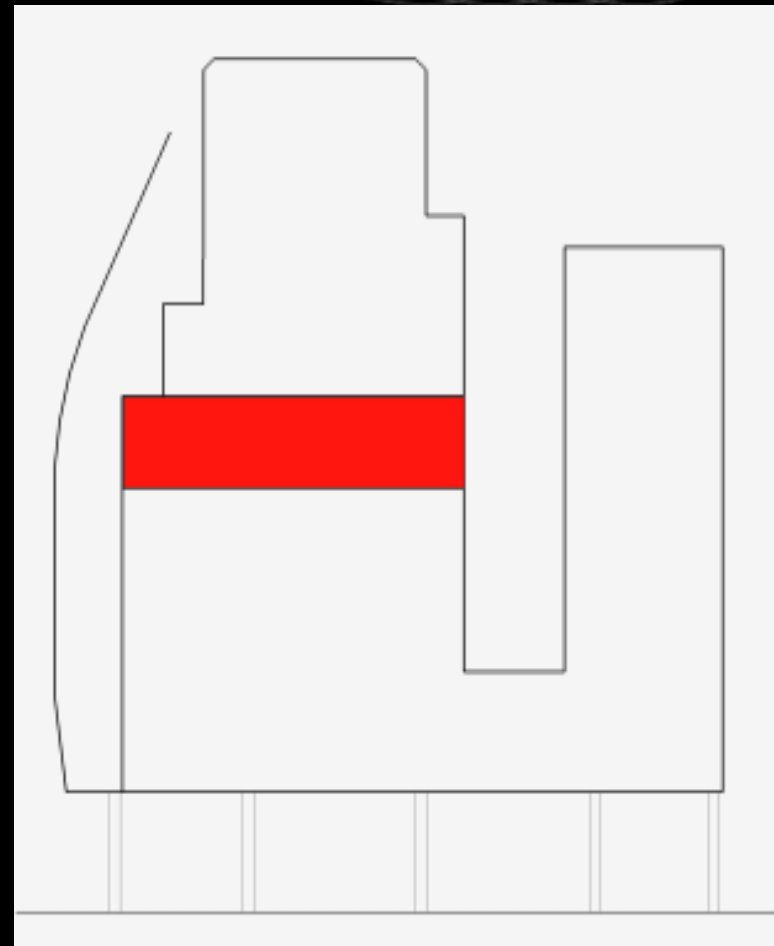
Flexibility & Modularity – our solution

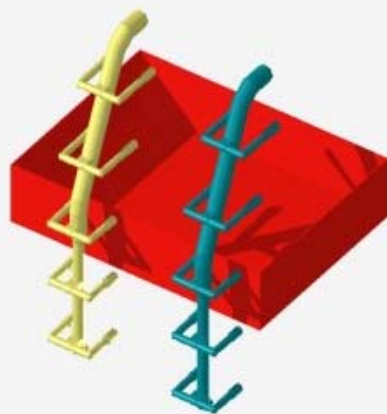
- ❑ The Laboratory is designed around a series of repetitive modules
- ❑ Modules are stacked both horizontally and vertically (shoe boxes)
- ❑ Modules are serviced from outside the laboratory space
- ❑ Modules are designed for multiple configurations with minimum modification to Services



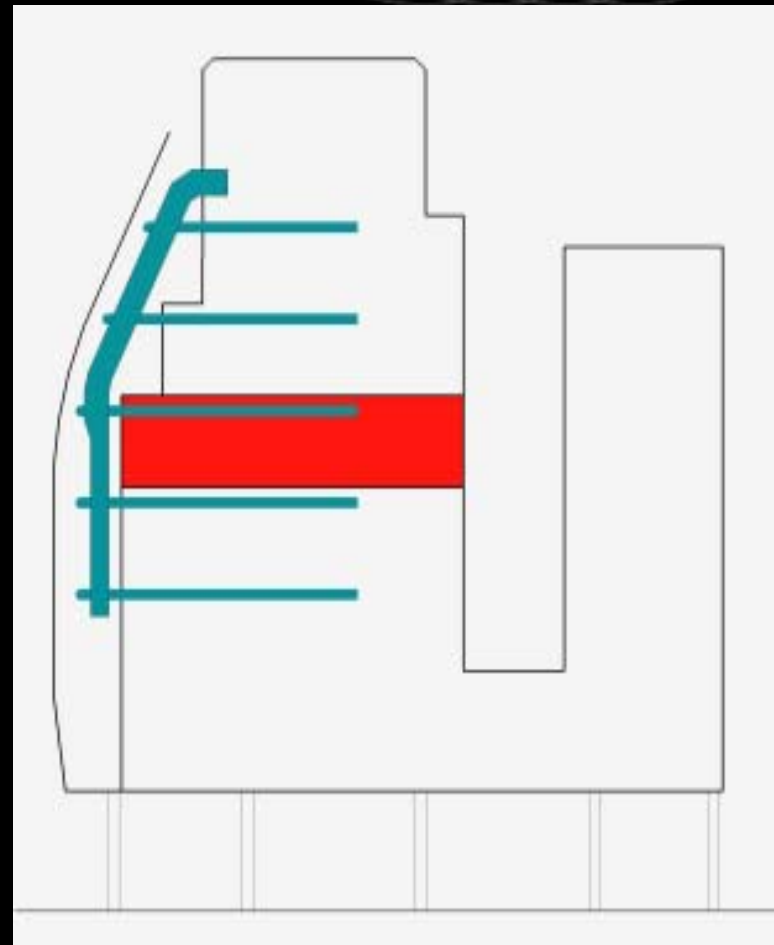


LAB MODULE





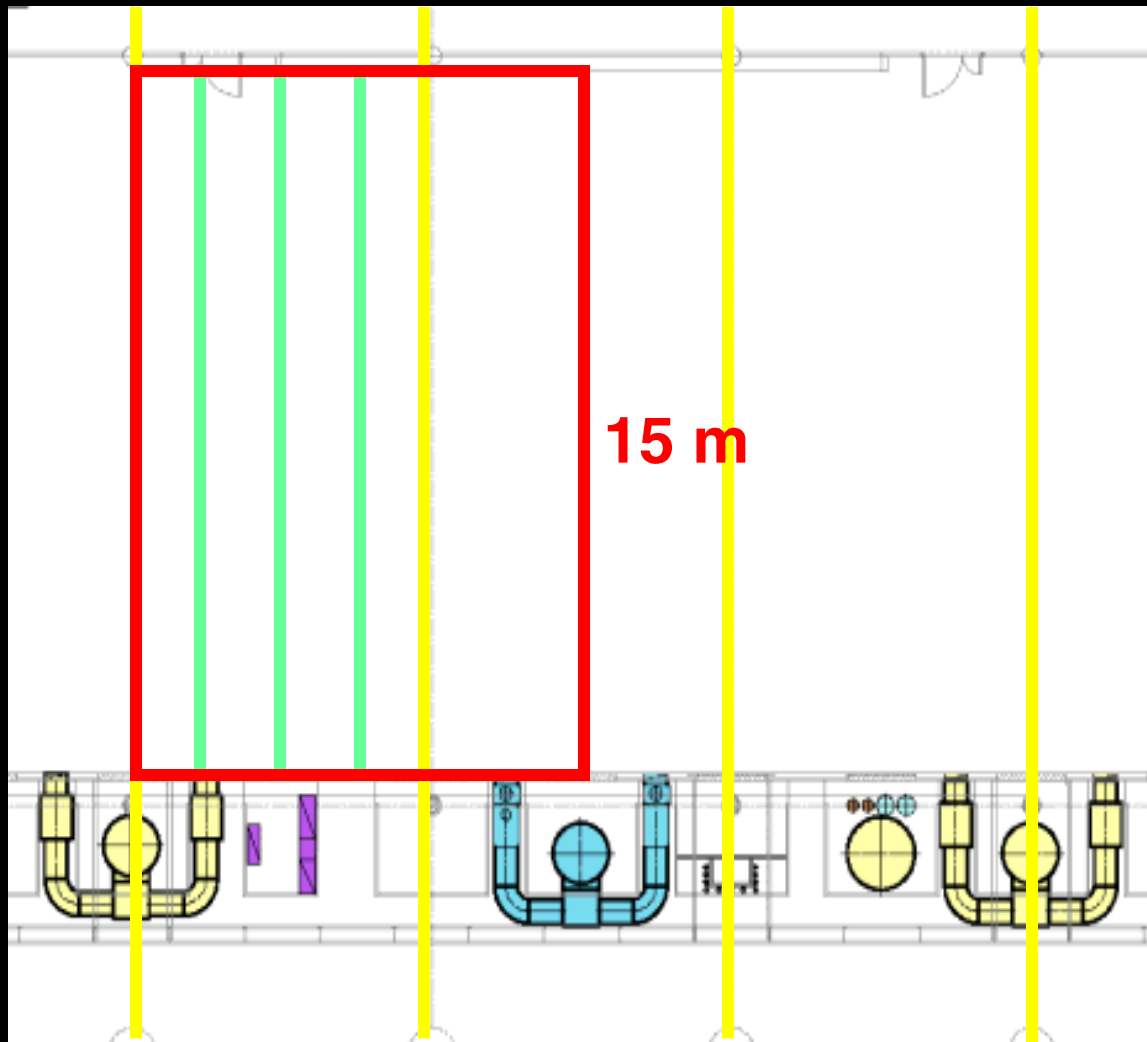
LAB MODULE



3.3 m

9.9 m

6.6 m

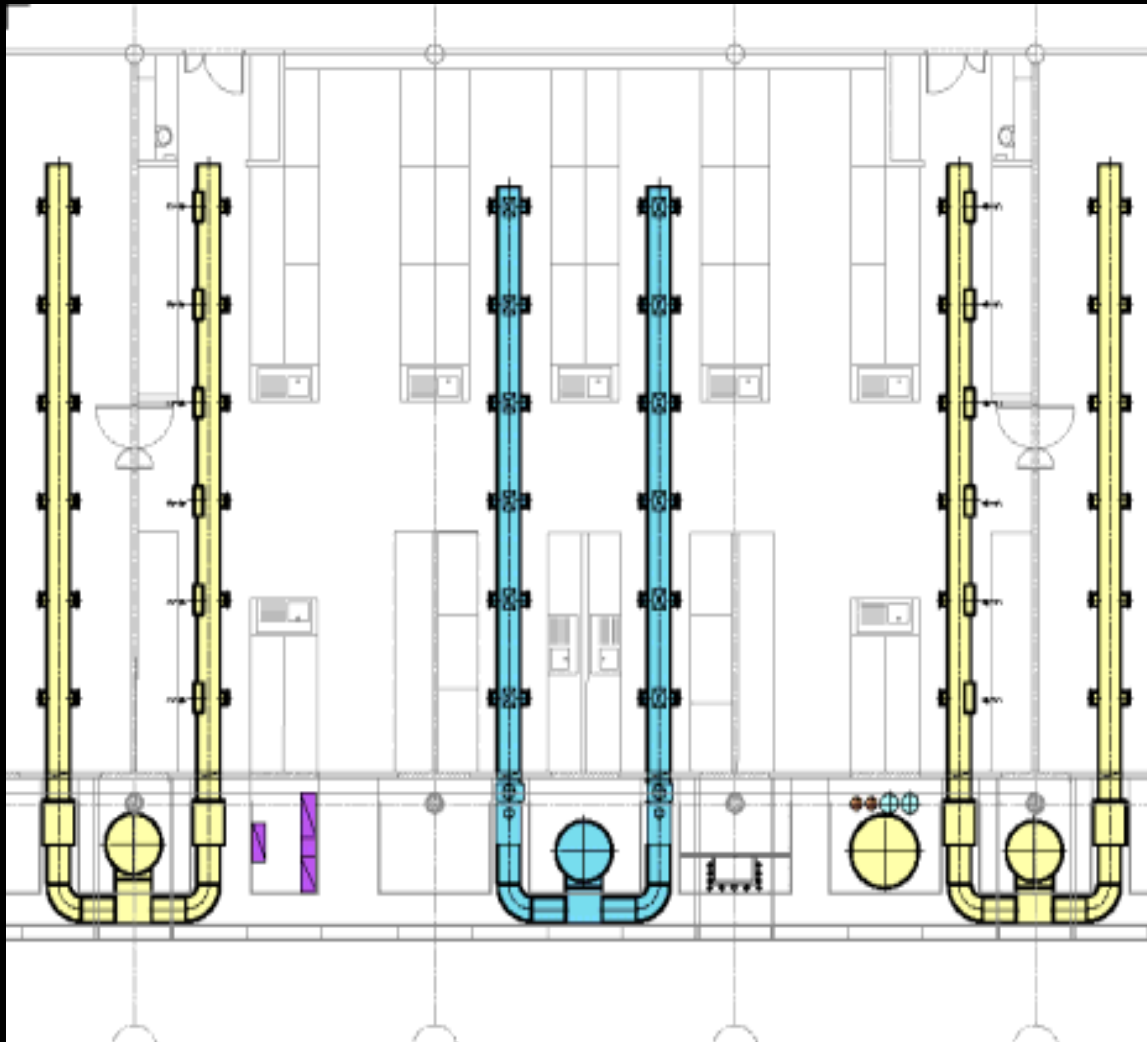


Bench Pitch

Structural Grid

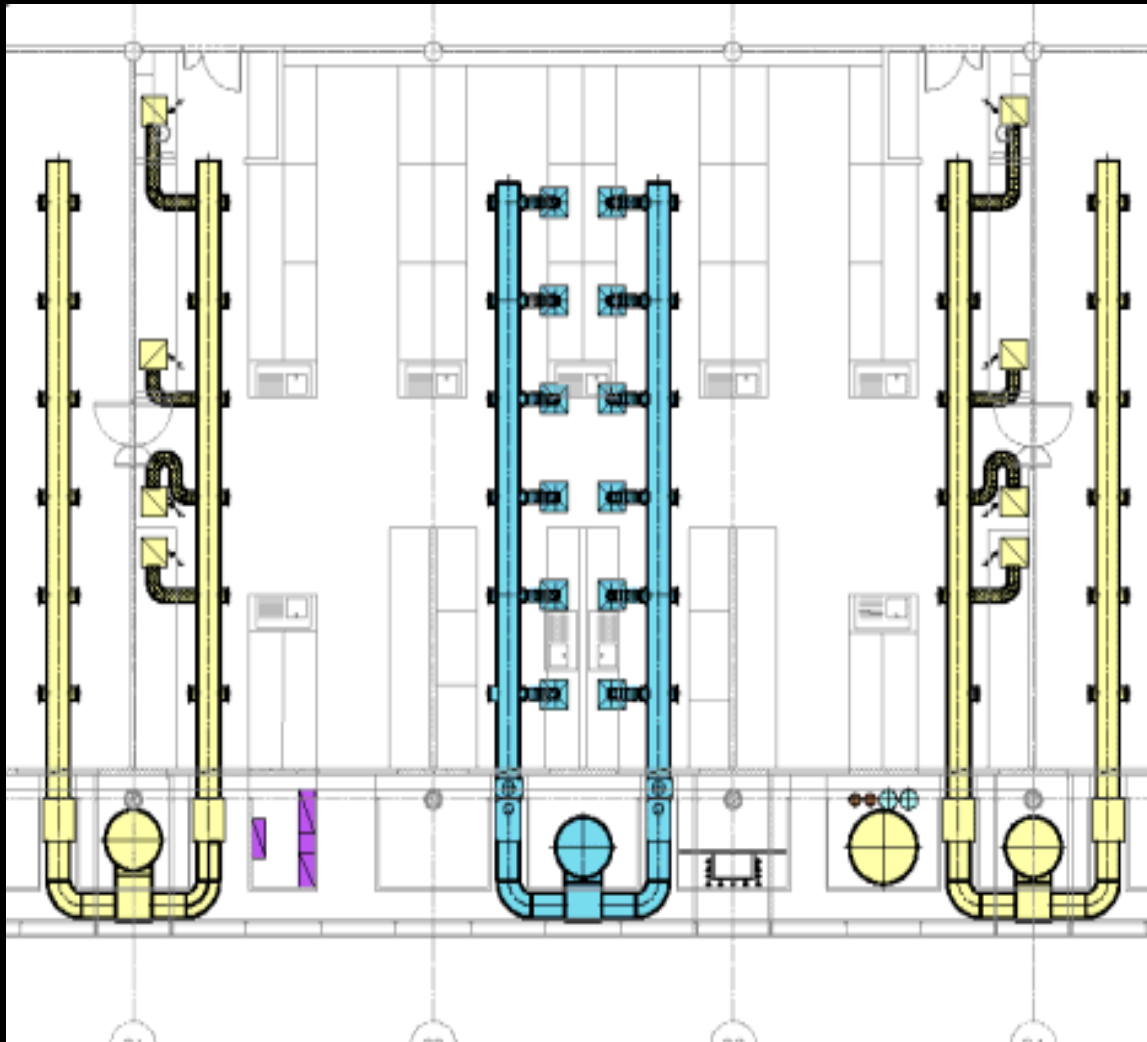
Lab Module

SHELL AND CORE



**GENERIC FITOUT
OPEN PLAN
NO CEILING**

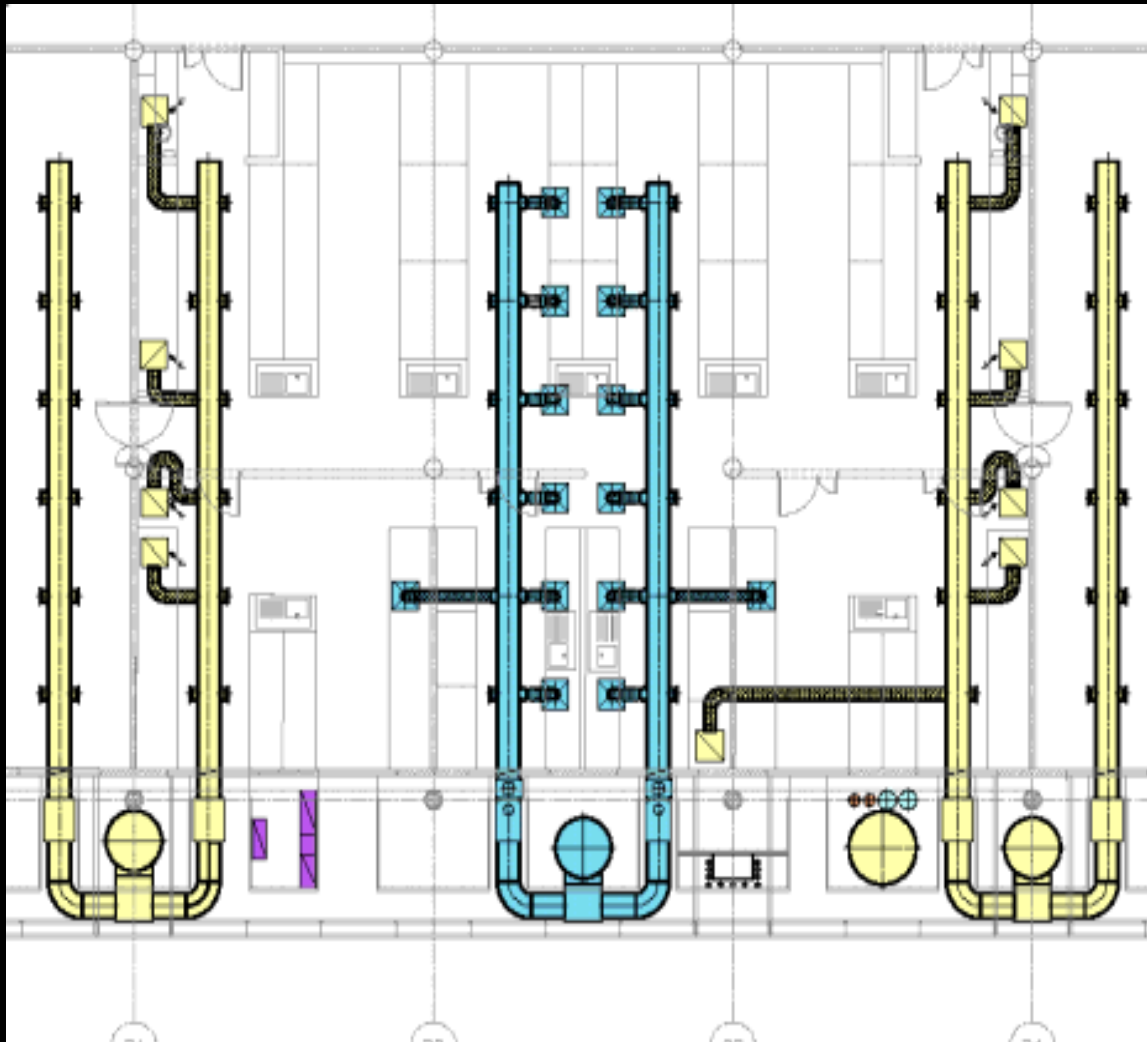
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GENERIC FITOUT OPEN PLAN CEILING

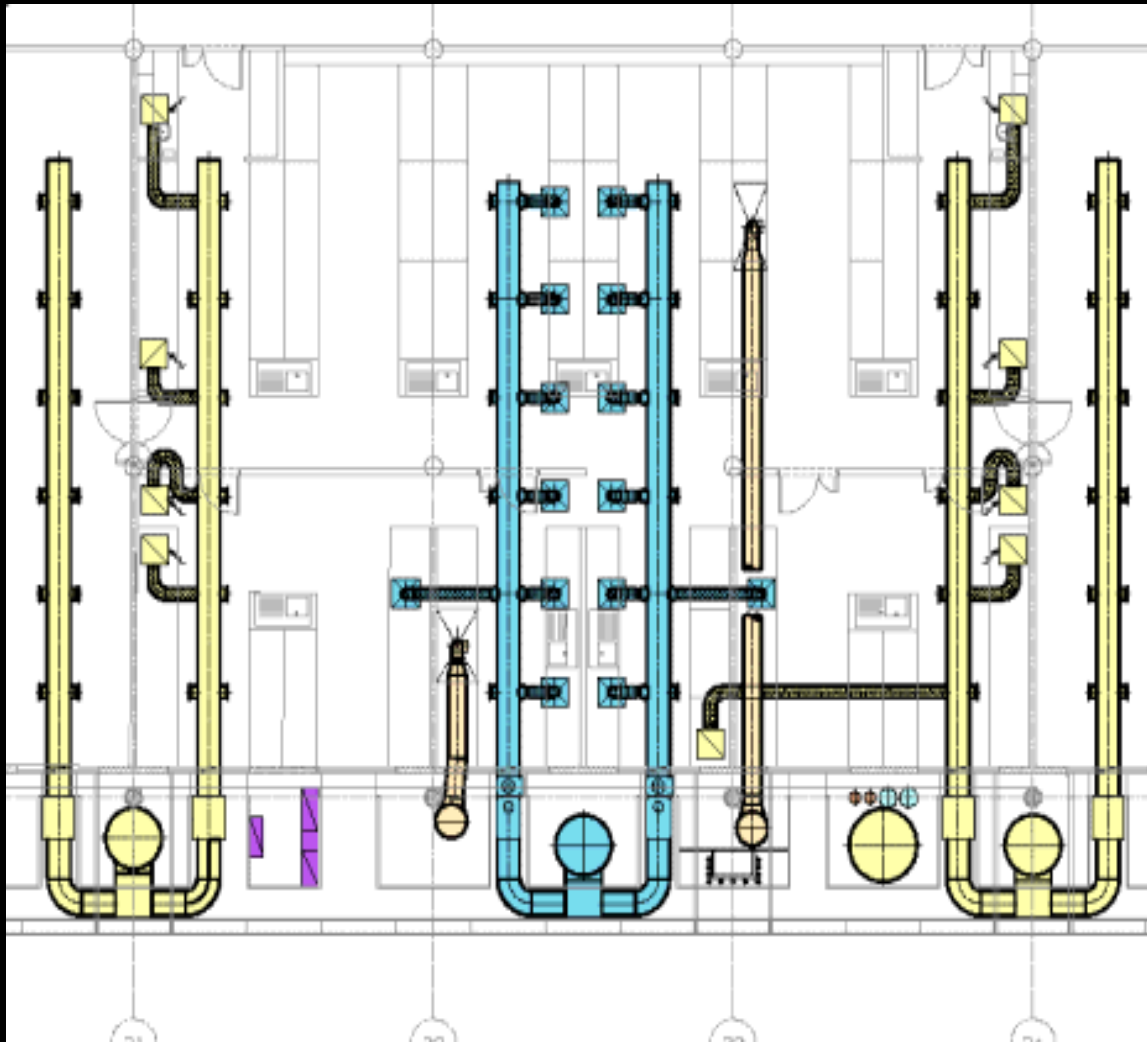
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SPECIFIC FITOUT

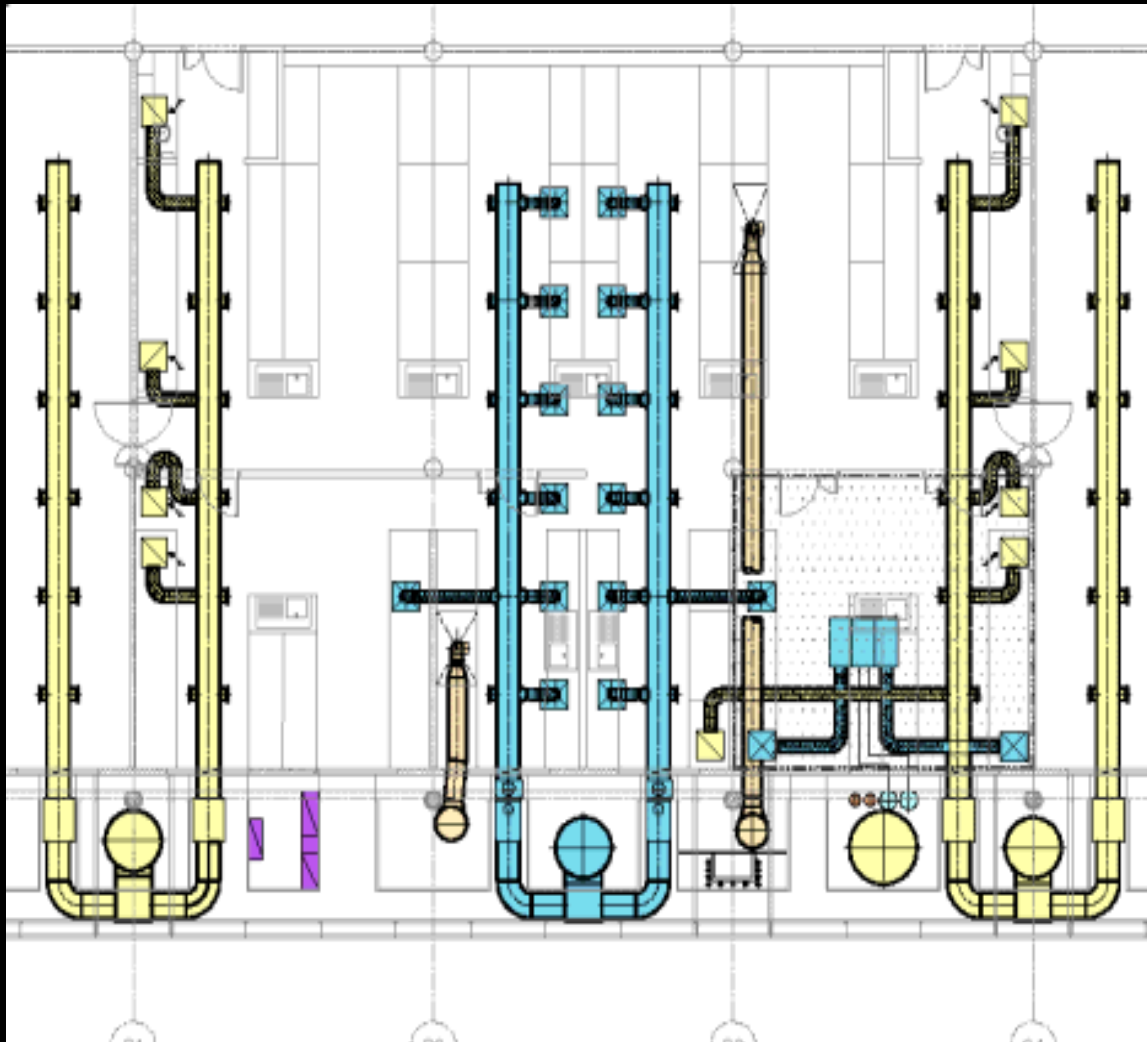
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FUME CUPBOARDS

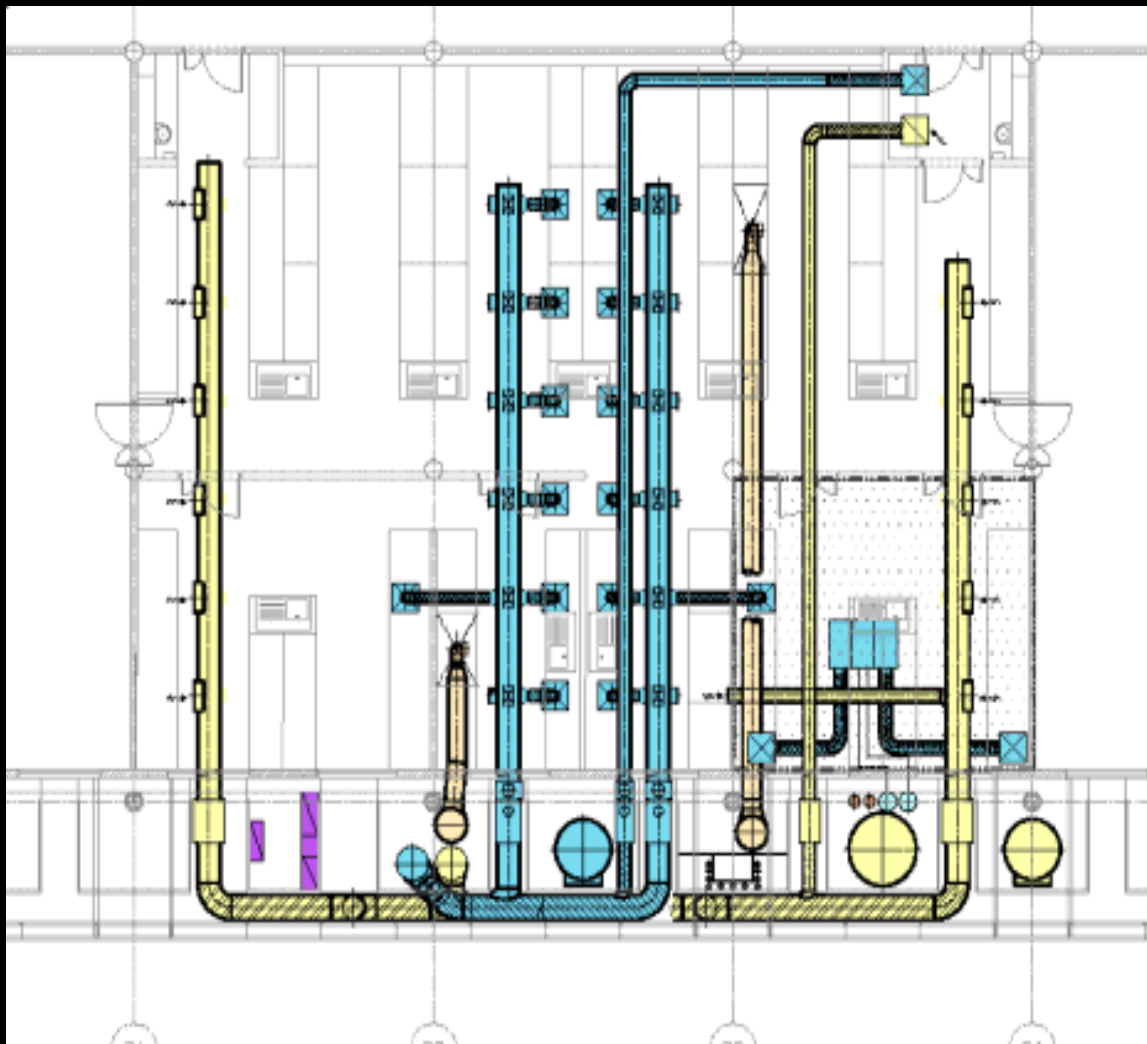
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HIGH LOAD AREA

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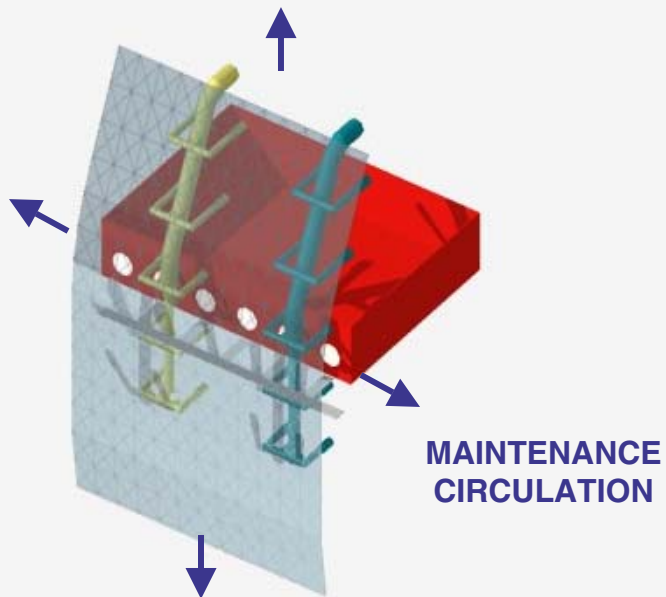


CAT 3 LABORATORY

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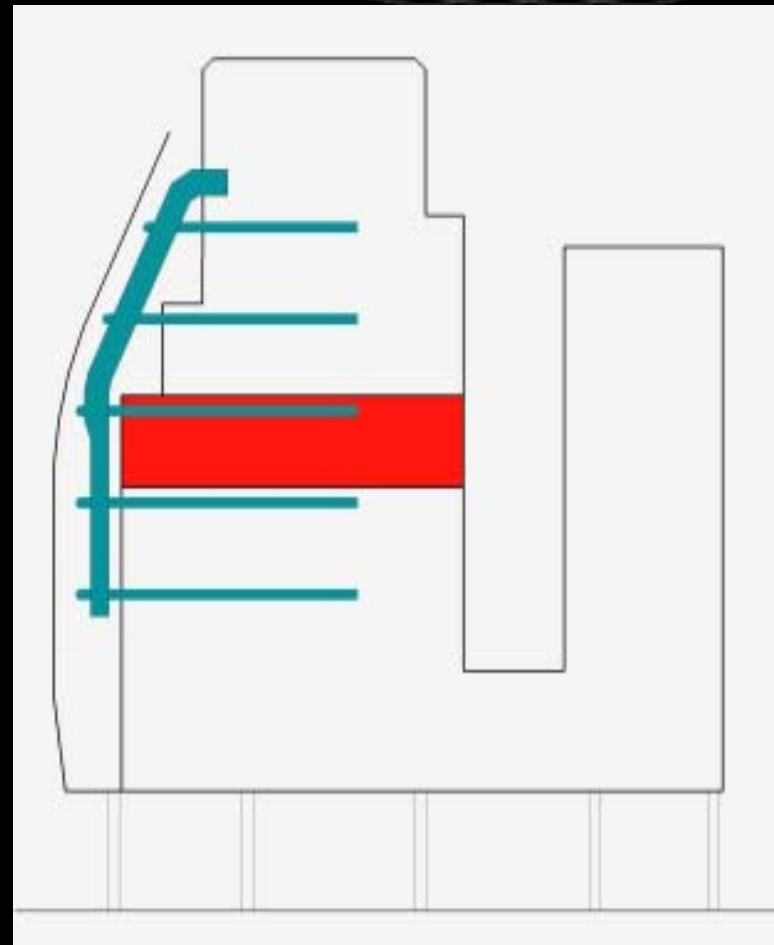


**STACK EFFECT
(SUMMER COOLING, WINTER HEATING)**

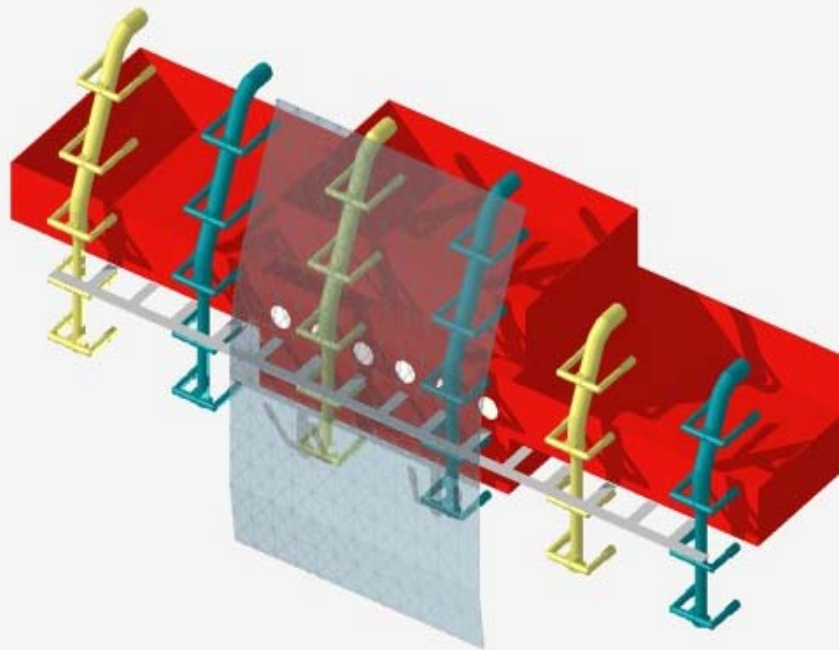


**MAINTENANCE
CIRCULATION**

**SERVICES ZONE ACTS AS ENVIRONMENTAL
BUFFER WITH VIEWS OUT**

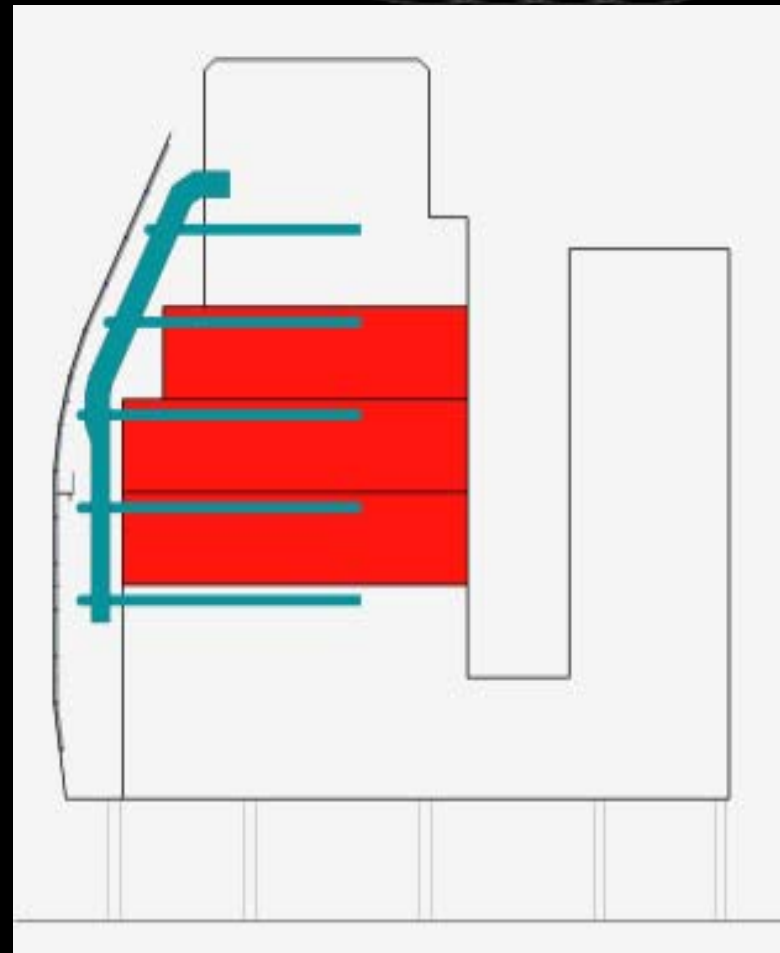


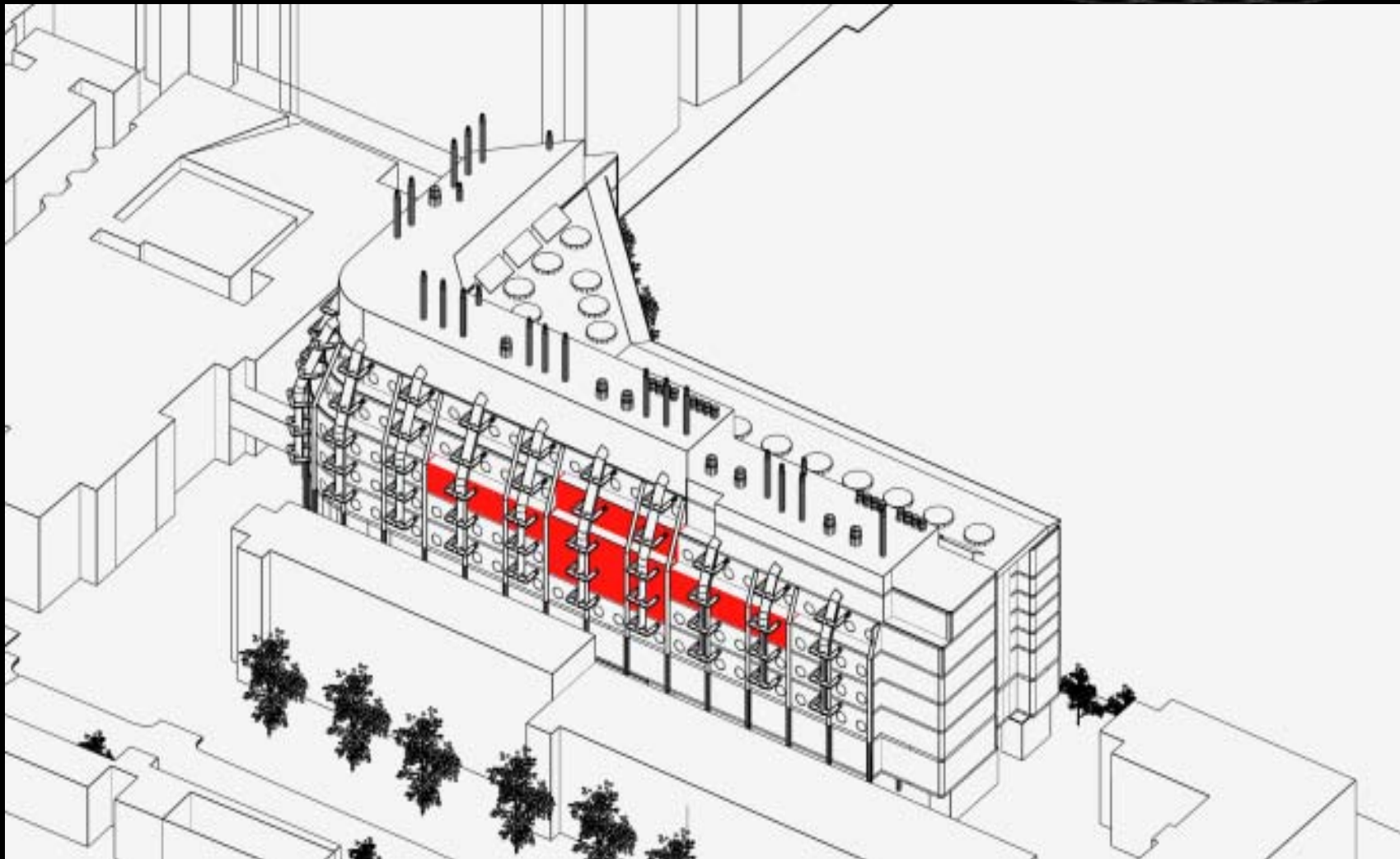
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FLEXIBILITY

**LAB MODULES CAN BE SERVICED
INDEPENDENTLY WITHOUT DISRUPTION
TO OTHERS**





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Modularity in Construction



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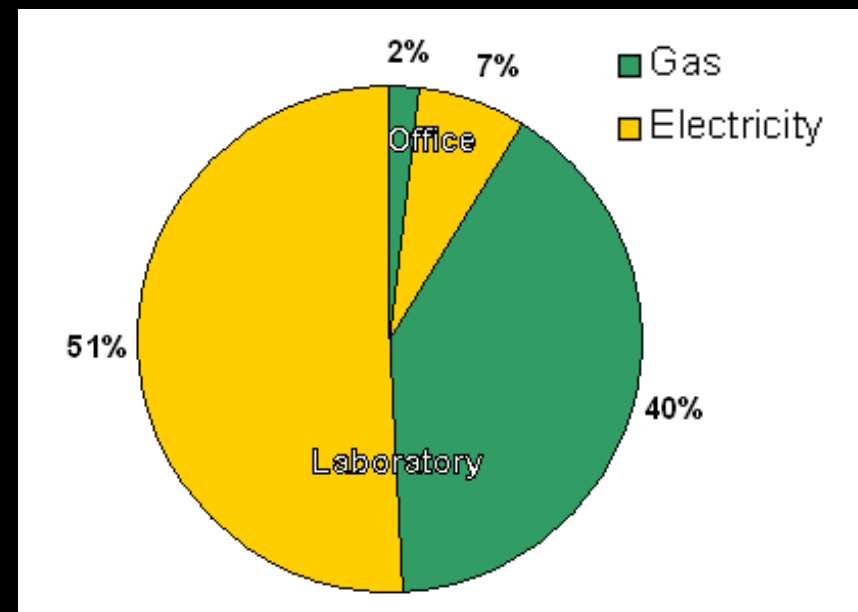
Concept Design - Saving Energy

- ❑ Energy Minimisation Measures
- ❑ Energy Recovery Measures
- ❑ Alternative Energy Sources
- ❑ Operational Energy Savings
- ❑ Life Cycle / Embedded Energy Minimisation

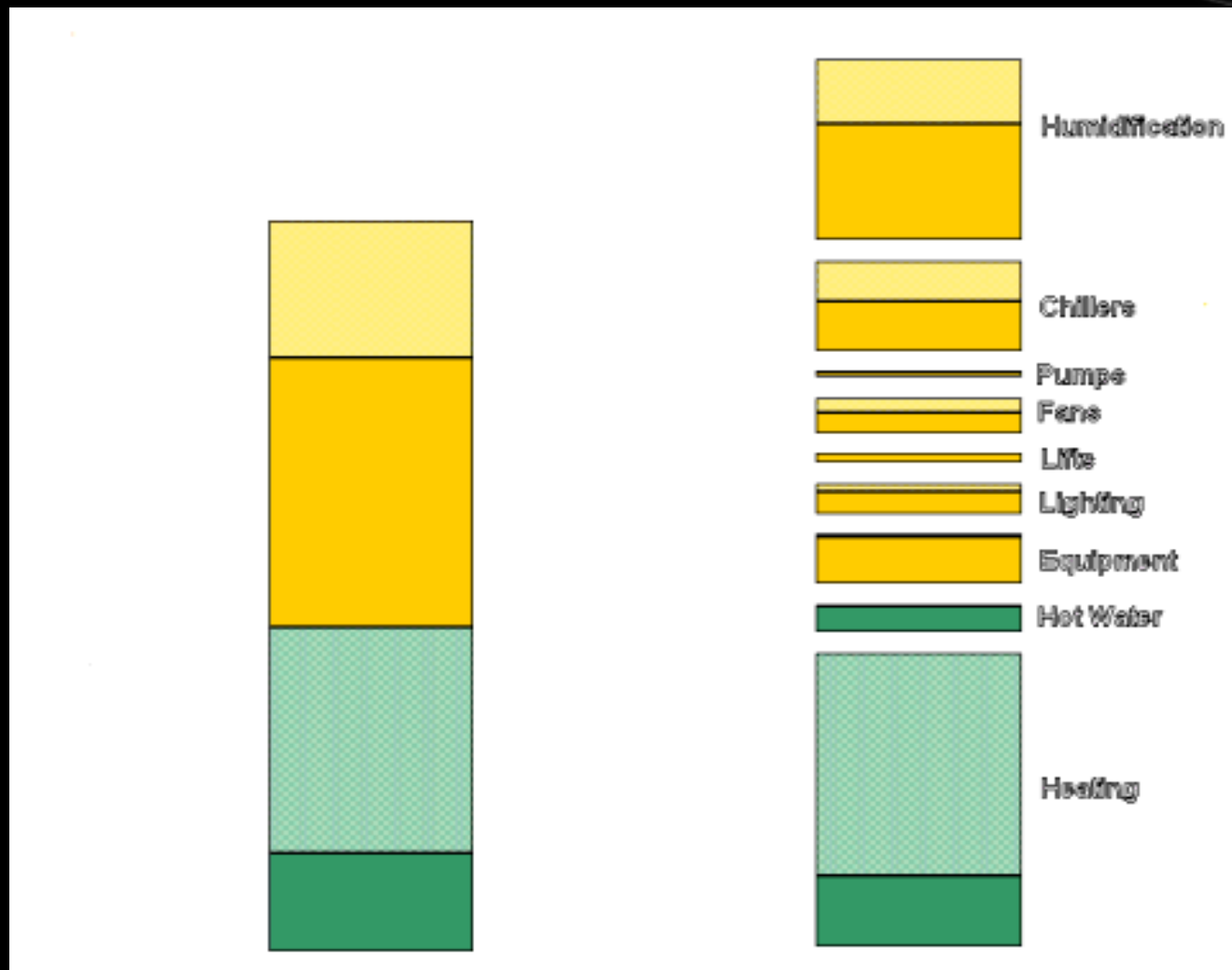


Energy - Who are the culprits ?

- ❑ Focus efforts on the big Energy Users
- ❑ Focus initially on Primary Energy Users
- ❑ Design time is expensive time – use it well
- ❑ Identify Future targets but keep focused

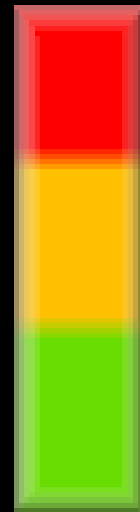
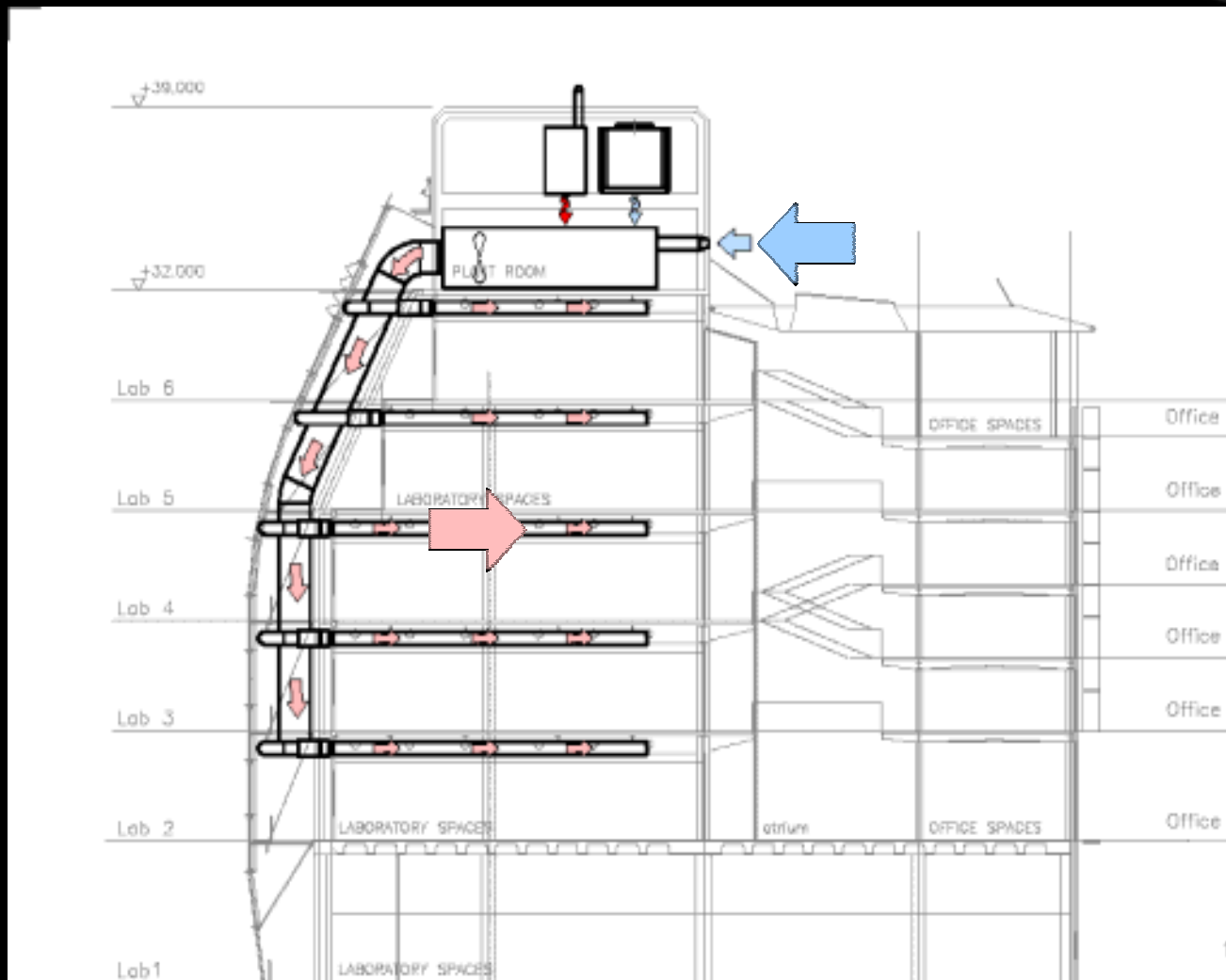


Energy Savings – Initial Assessment



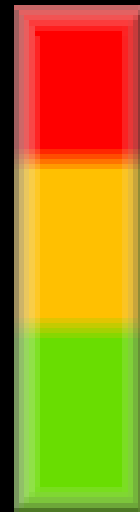
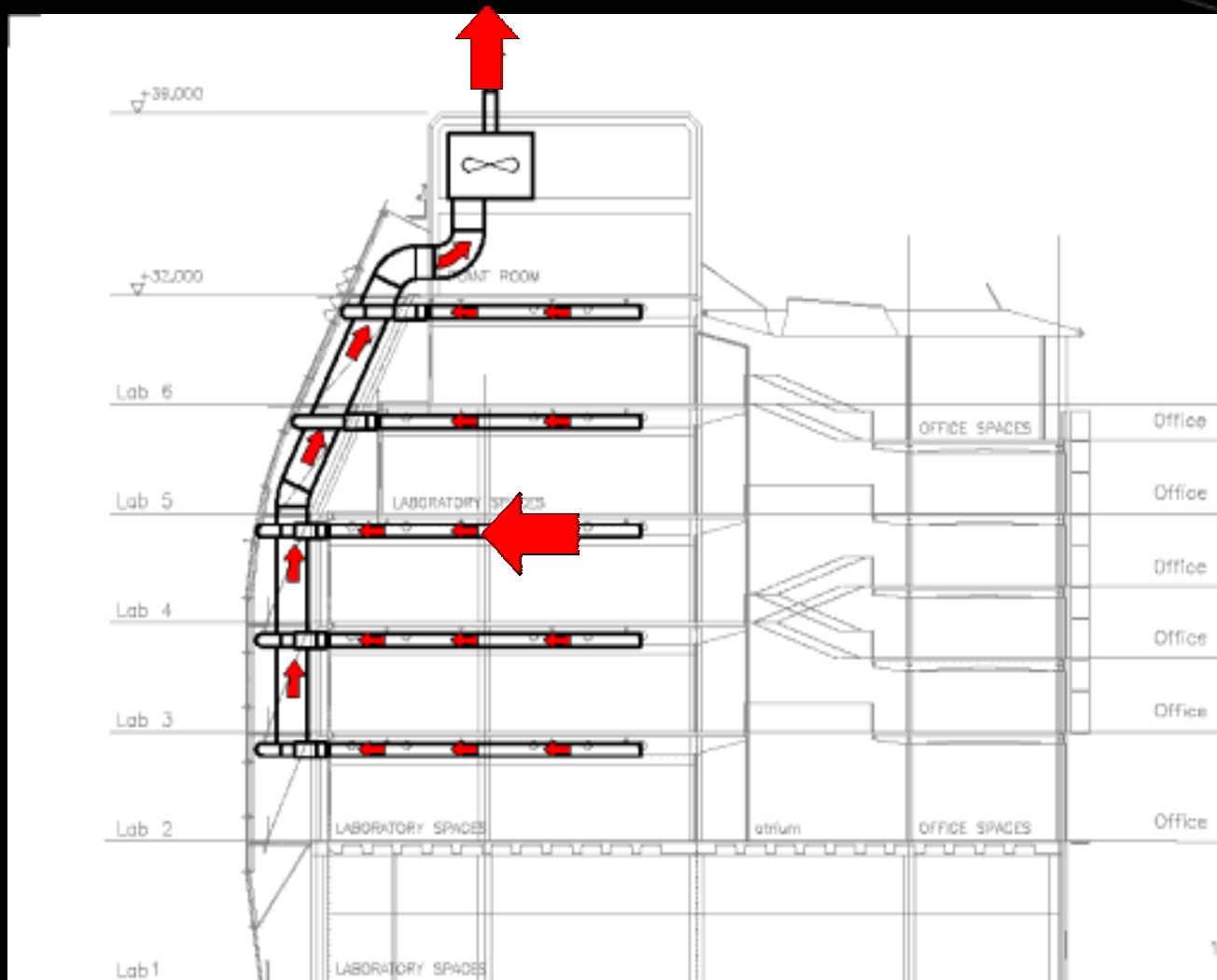
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System Arrangement



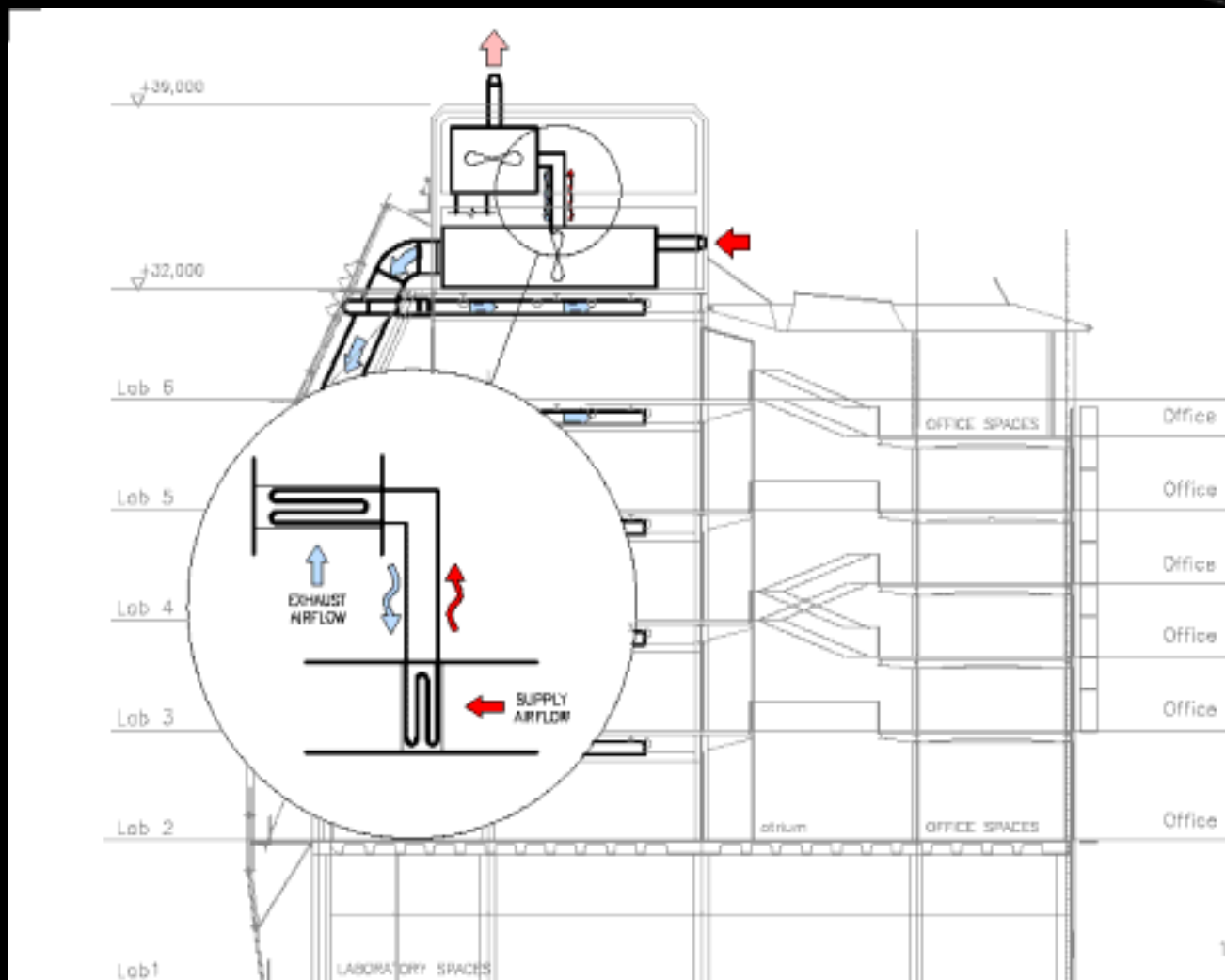
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System Arrangement



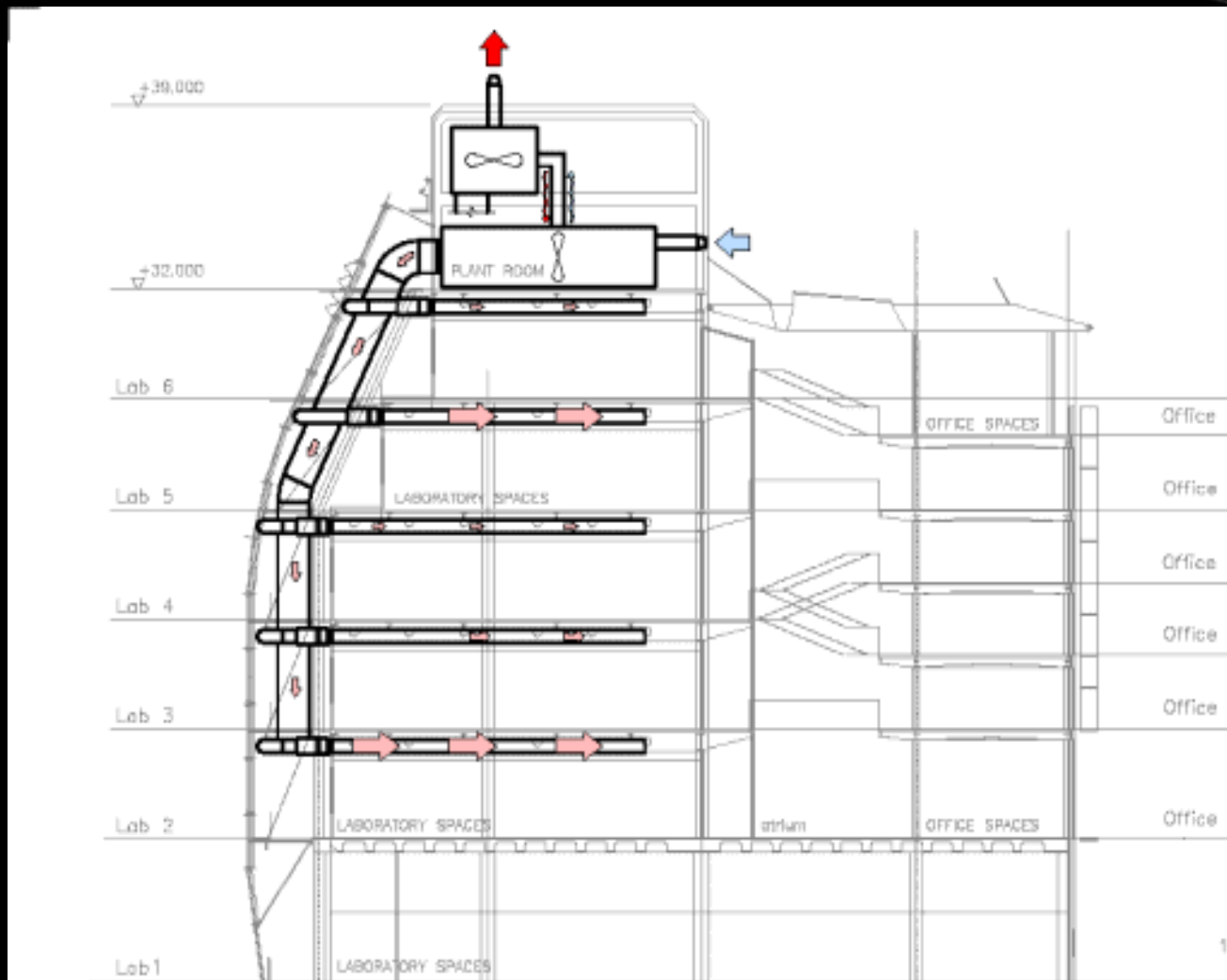
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Key Measures – Energy recovery



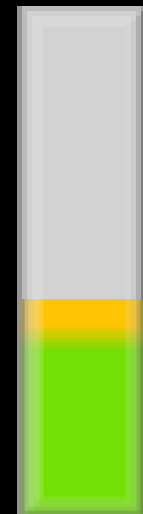
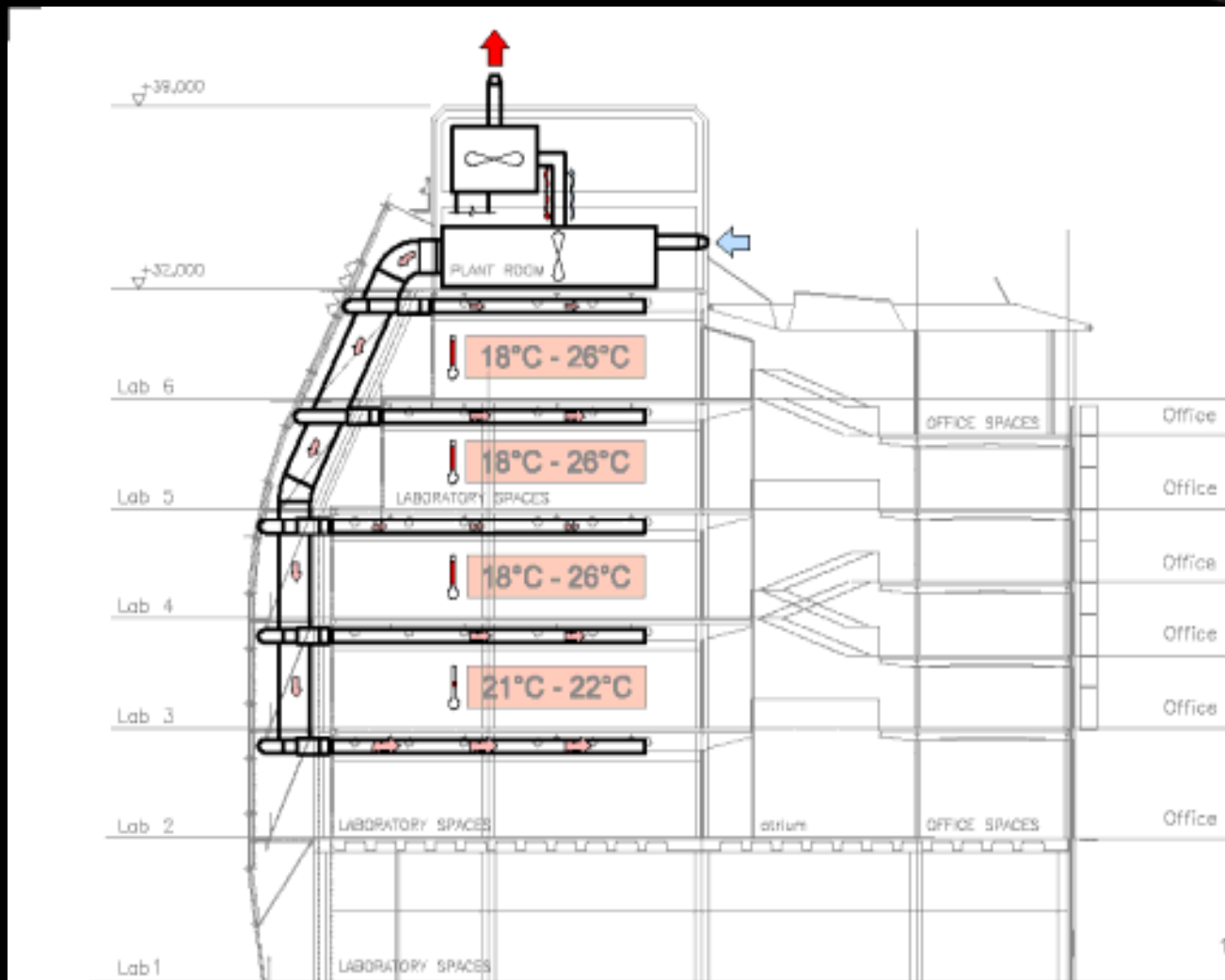
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Key Measures – Variable Volume



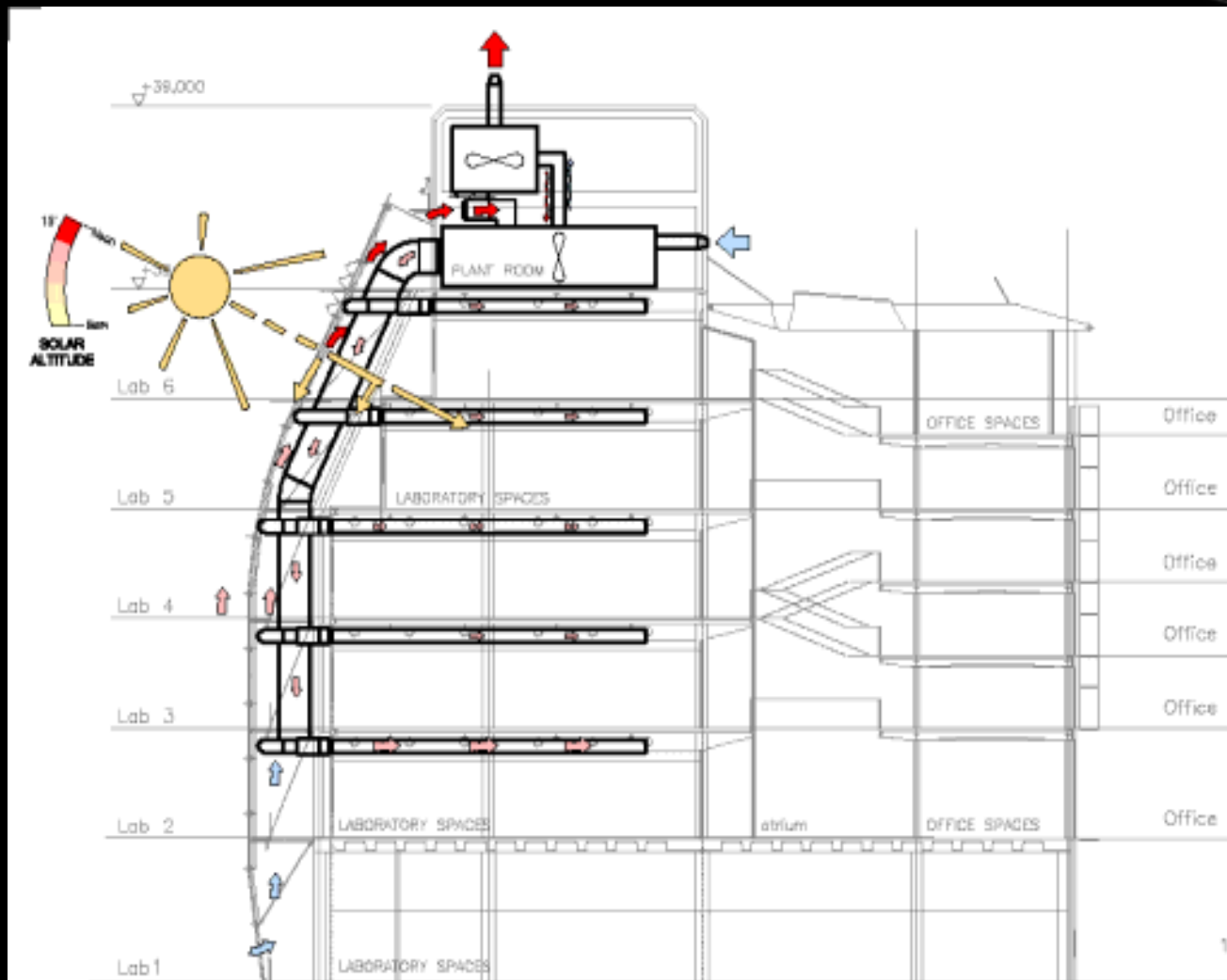
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Key Measures – Lab Conditions

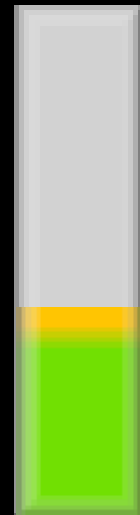


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Key Measures – Active Facade

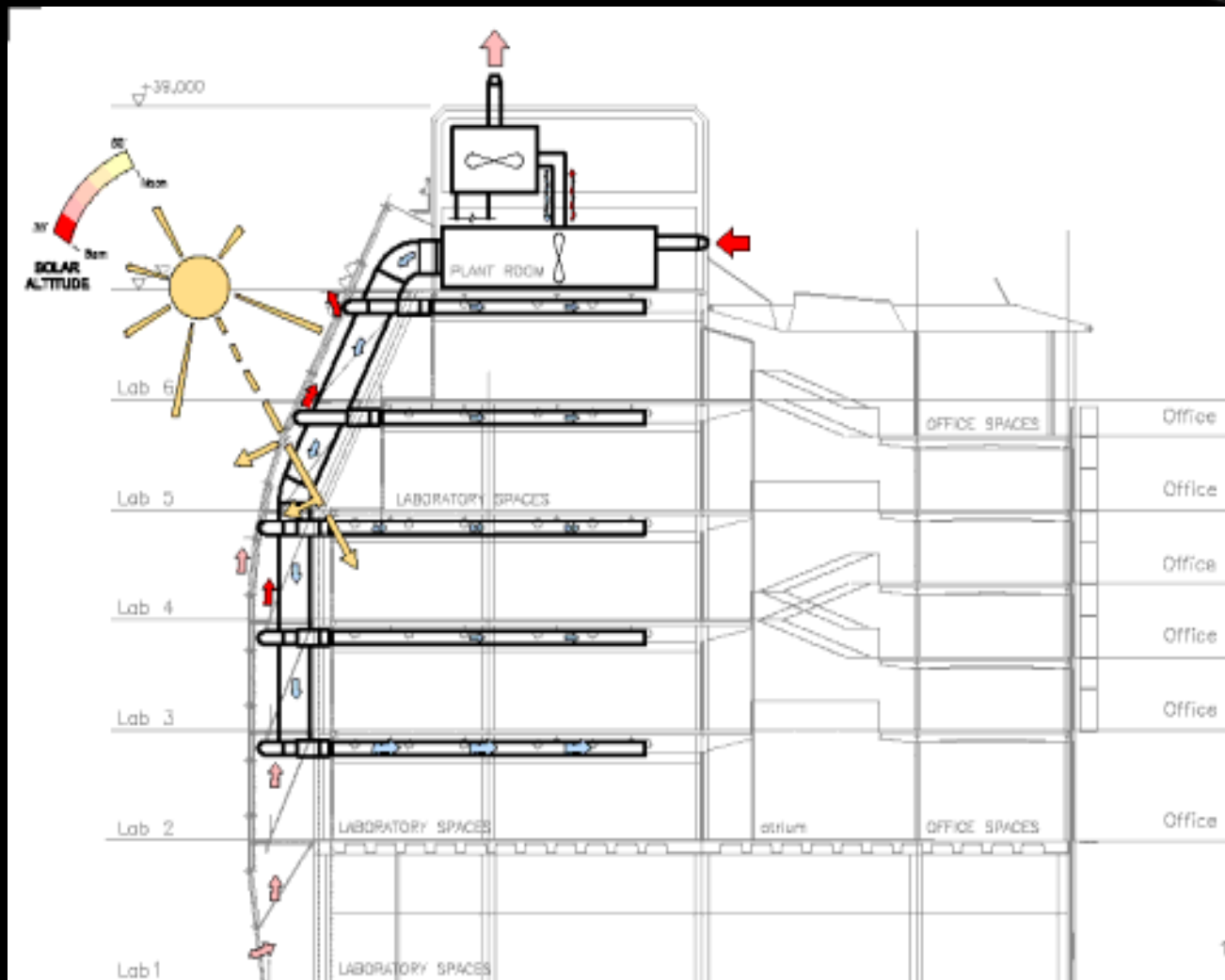


Winter

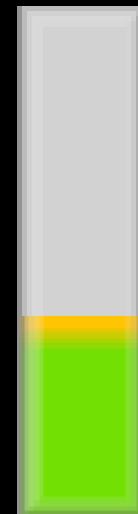


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Key Measures – Active Facade

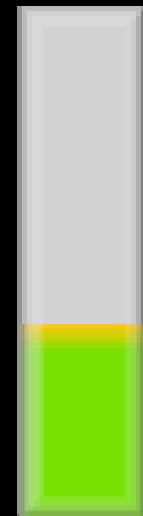
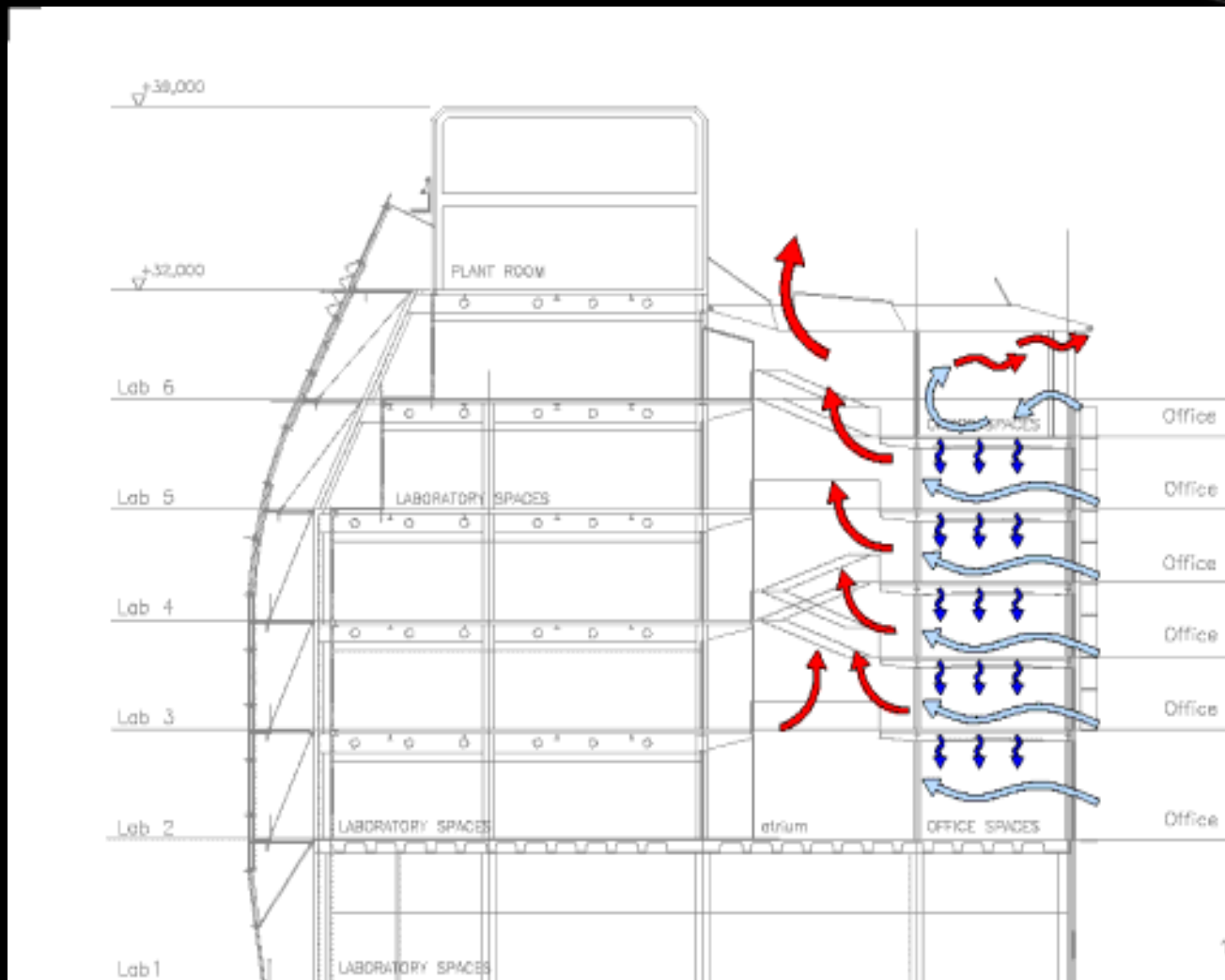


Summer



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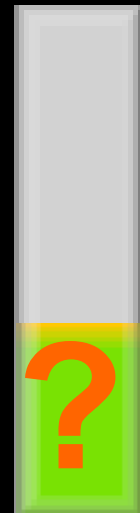
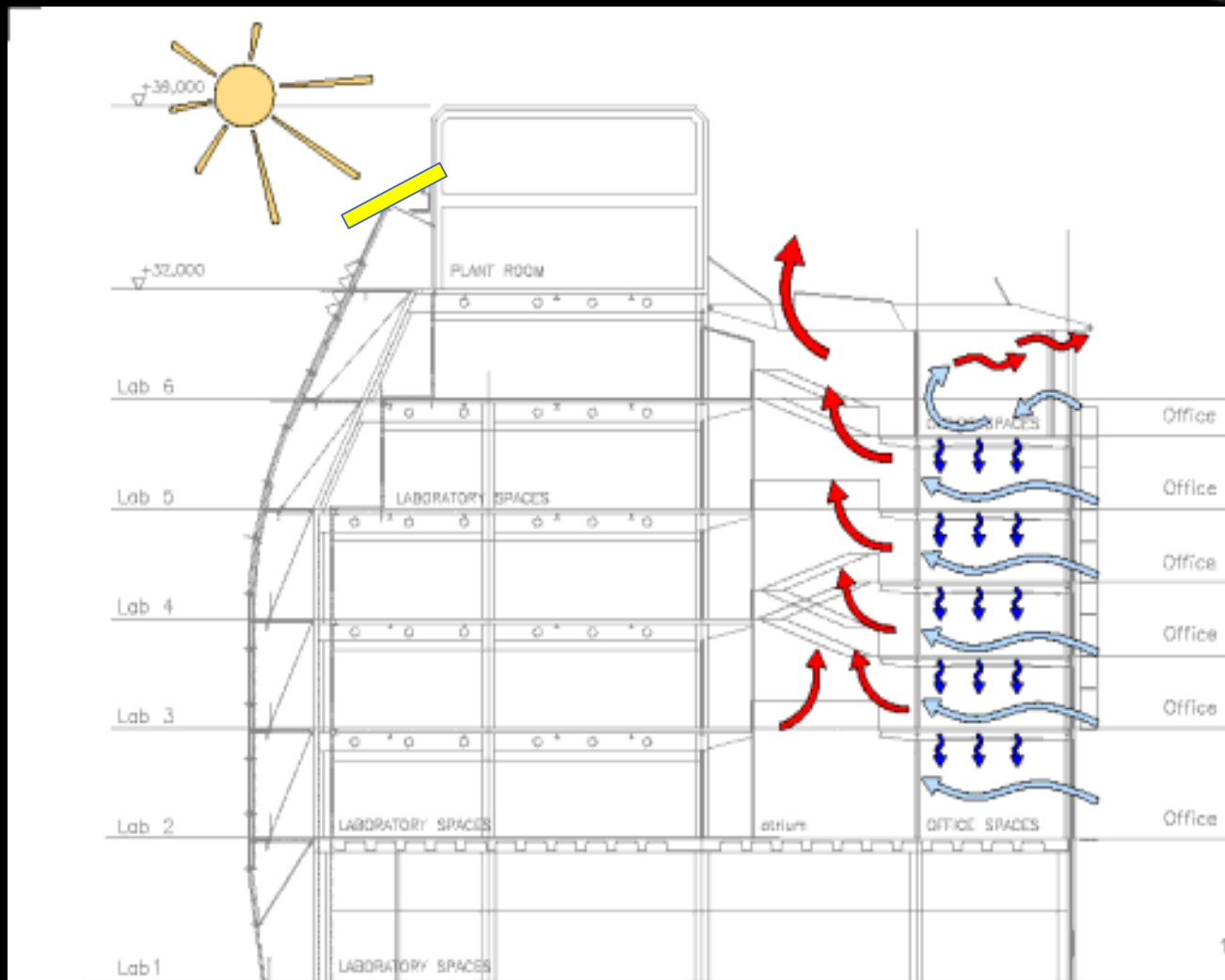
Key Measures – Natural Ventilation



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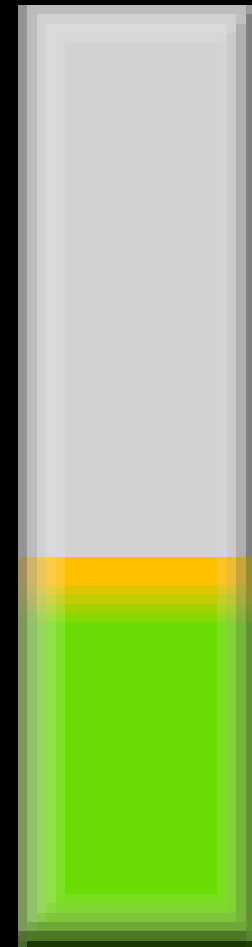
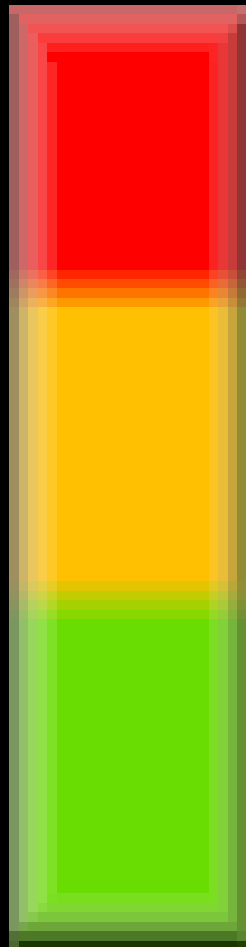
Other Opportunities



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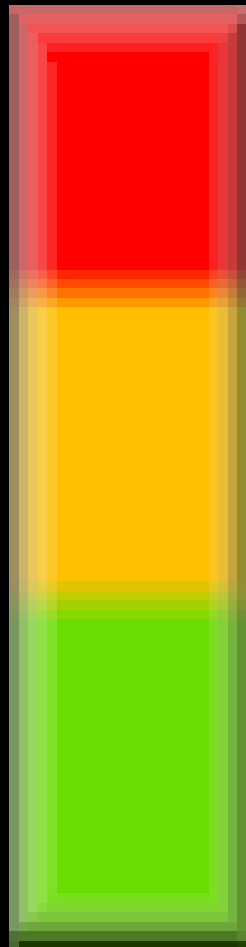
4,700,000 KWh

1,800,000 KWh

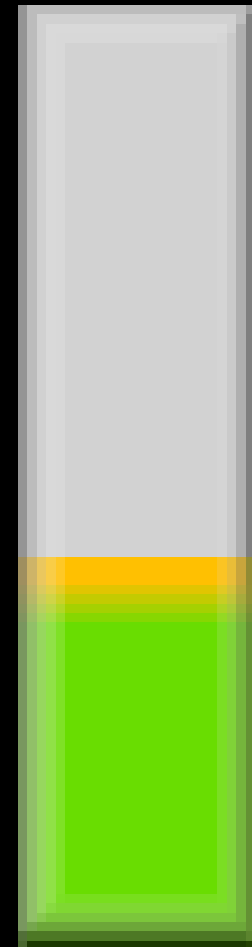


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411 Tonnes Carbon

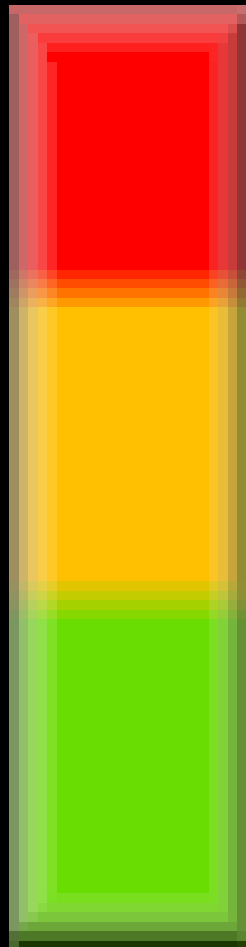


164 Tonnes Carbon

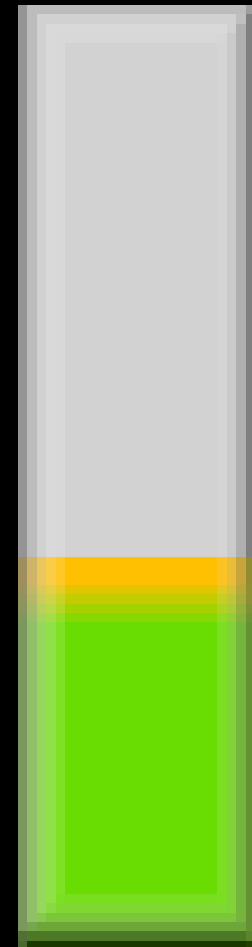


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£ 140,000 per year



£ 56,000 per year



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Detail Design - Fine Tuning

- ❑ Design Equipment for how the building is expected to operate
- ❑ Don't over design
- ❑ Design the systems to 'sit' comfortably on the expected operating point
- ❑ Choose equipment for Operational Efficiency at this point
- ❑ Consider Maximum Expected Duty as a check

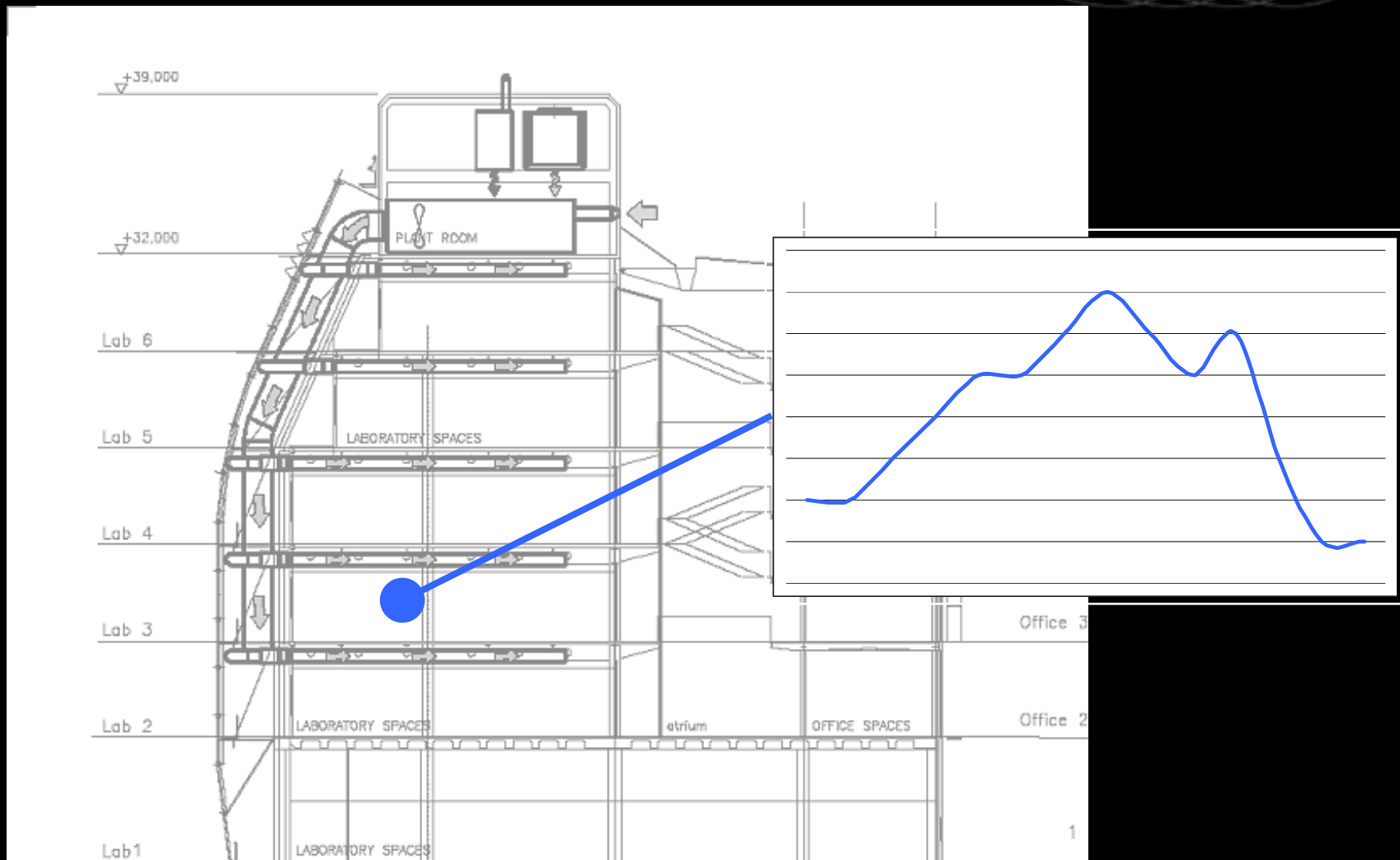


Fine Tuning building design

- ❑ Why aren't buildings designed the same way ?
- ❑ How we are doing it :
 - Model the lab modules to determine the most probable operating range for primary systems on an individual module basis
 - Model the combination of lab modules to determine most likely system duty
 - Model the building systems and test the sensitivity of the system demands to various system configurations
 - Add detail information as the design progresses
 - Don't 'chase' floor plans

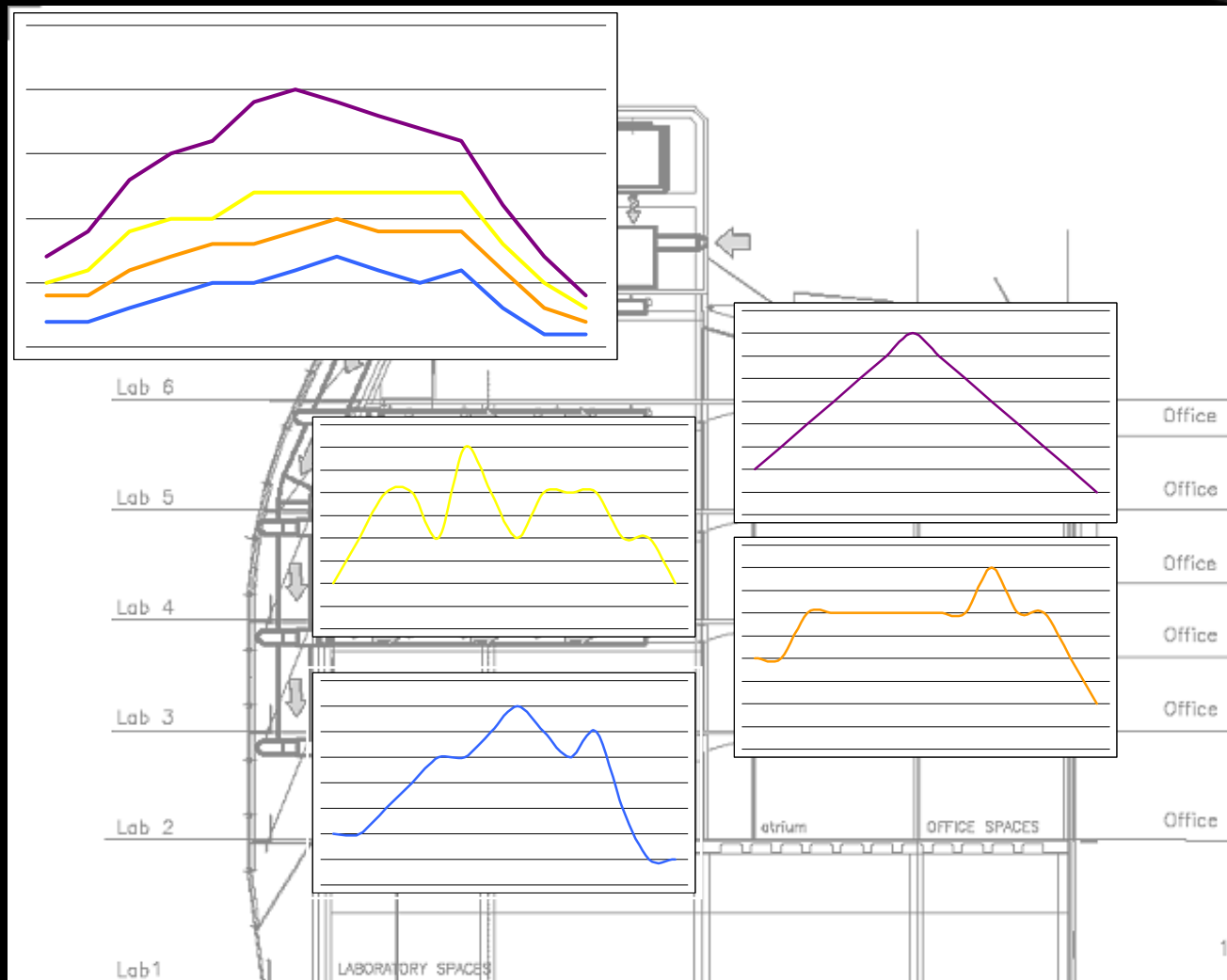


Laboratory Loads per module



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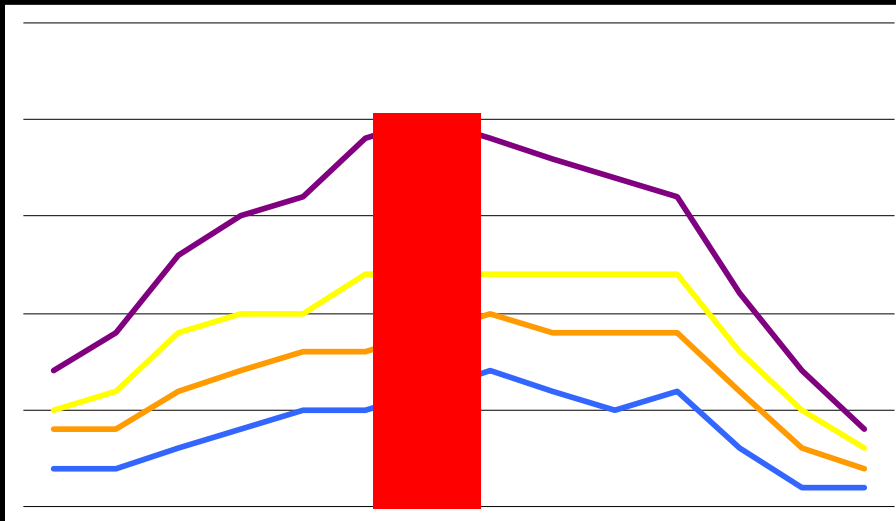
Laboratory Loads - combined



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Most Likely Loads

- ❑ But what is really happening at the point we have identified as the maximum duty ?
- ❑ Duty for all modules really varies up to the maximum duty
- ❑ Calculating the most likely load is a game of chance
- ❑ To analyse chance we need to use statistical / probability methods



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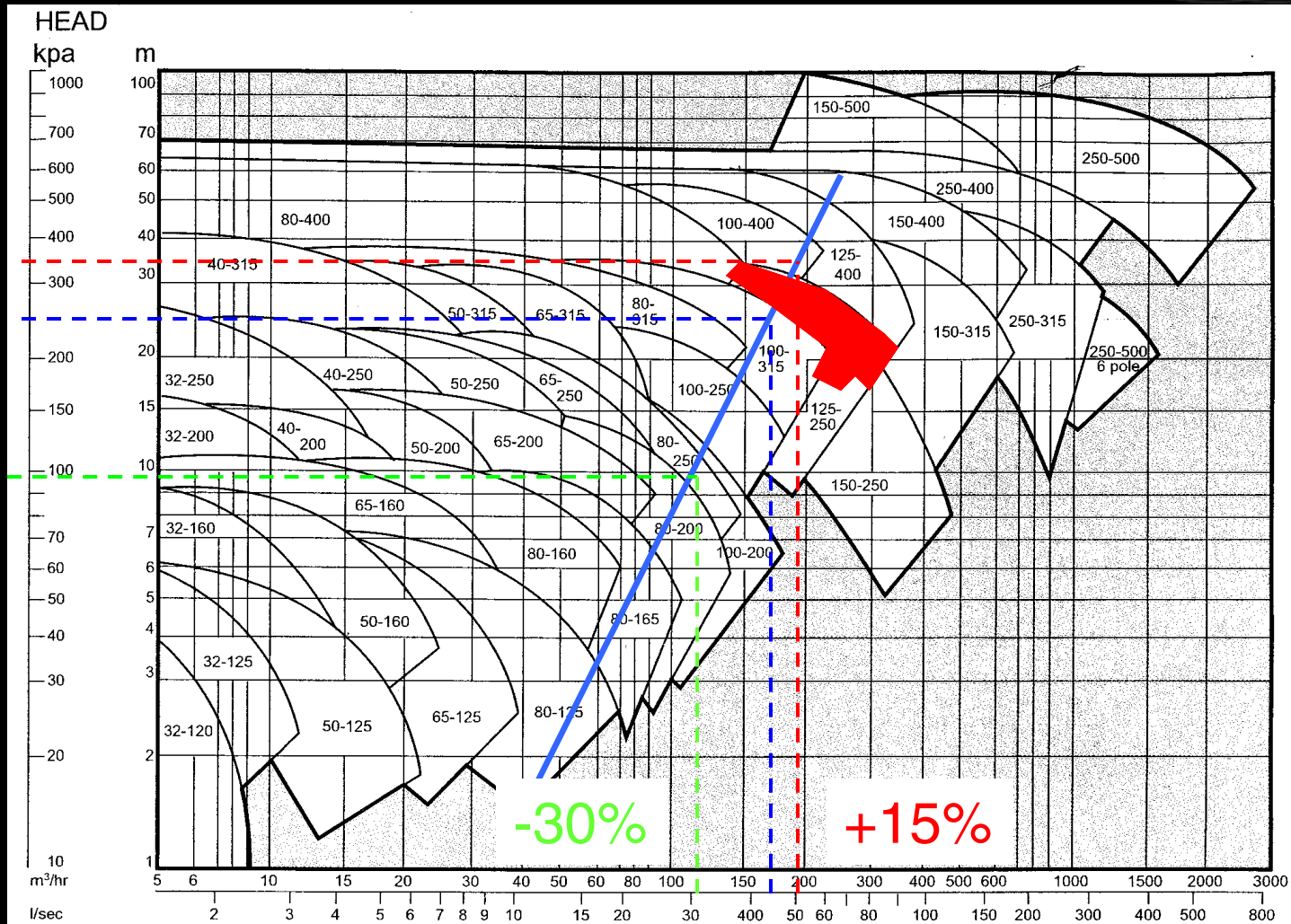


Implementation

- ❑ What does this mean in Practice ?
- ❑ Plant should be selected based on most probable duty
- ❑ Plant should be selected for maximum efficiency at this point
- ❑ Check high and low end operation
 - will the Mini do 90 mph (150 kph) at a squeeze ?
- ❑ Method can be applied to all variable duty systems

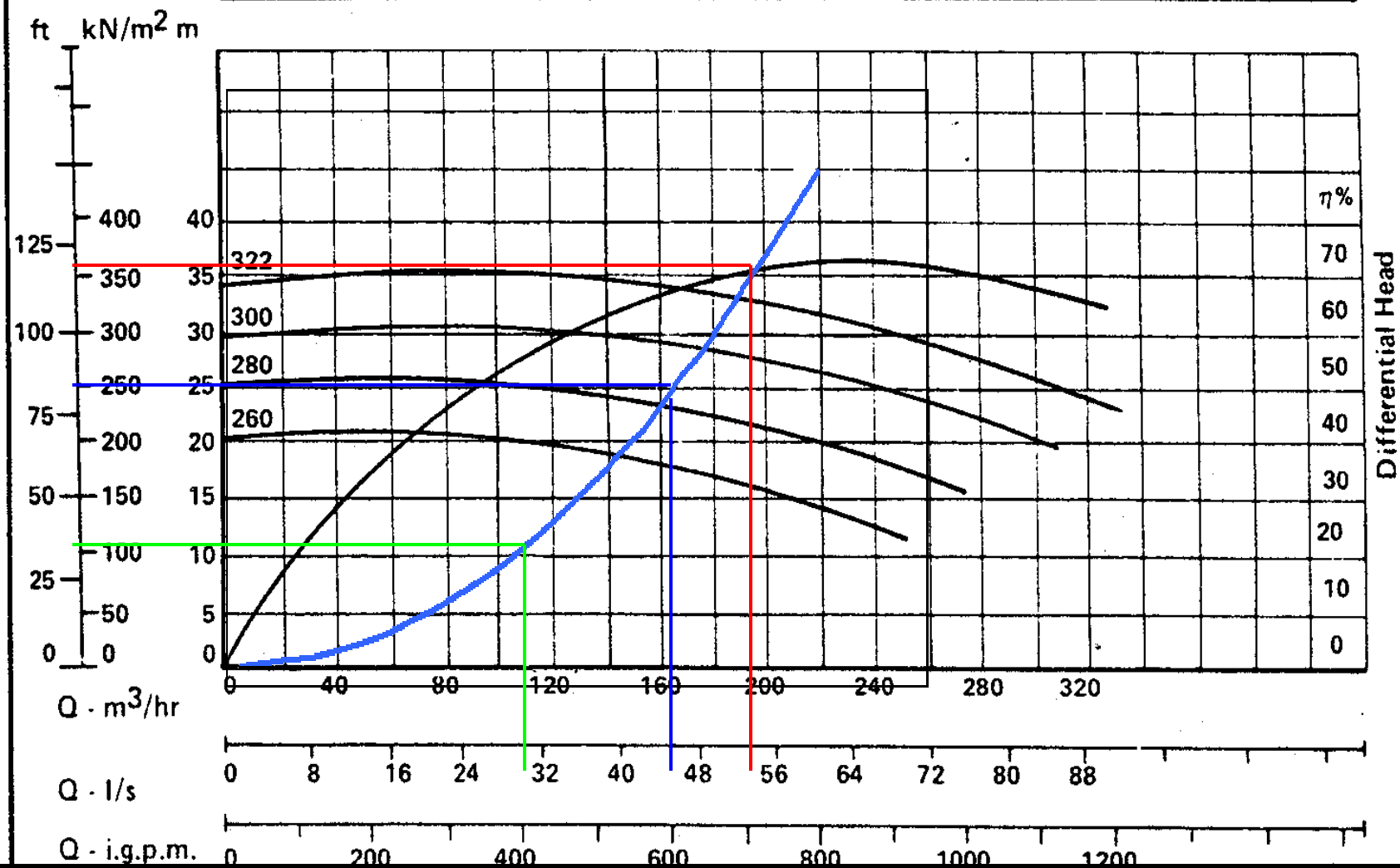


A Practical Example



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A Practical Example



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Operational Issues

- ❑ Relaxation of condition requirements where appropriate
- ❑ Group tight tolerance equipment
- ❑ Group high load equipment
- ❑ Recirculating Vs. Pass through hazard cabinets
- ❑ Operational Education



The Project today

- ❑ New Drivers – deliver maximum science for our buck
- ❑ Value Engineering to drive cost efficiencies
- ❑ BUT don't throw the baby out with the bath water
- ❑ The challenge is to retain key elements & provide value for money



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